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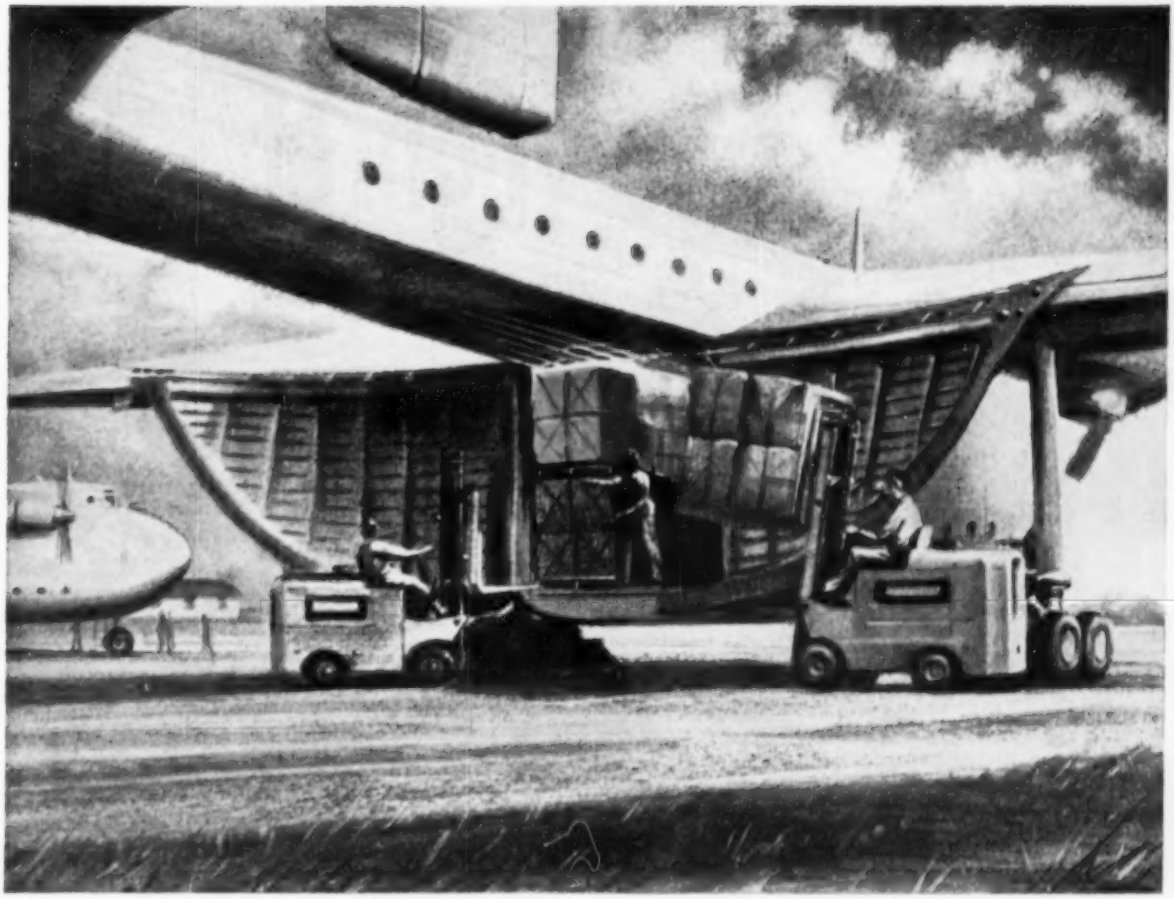

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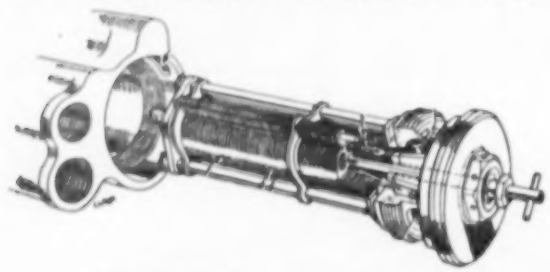

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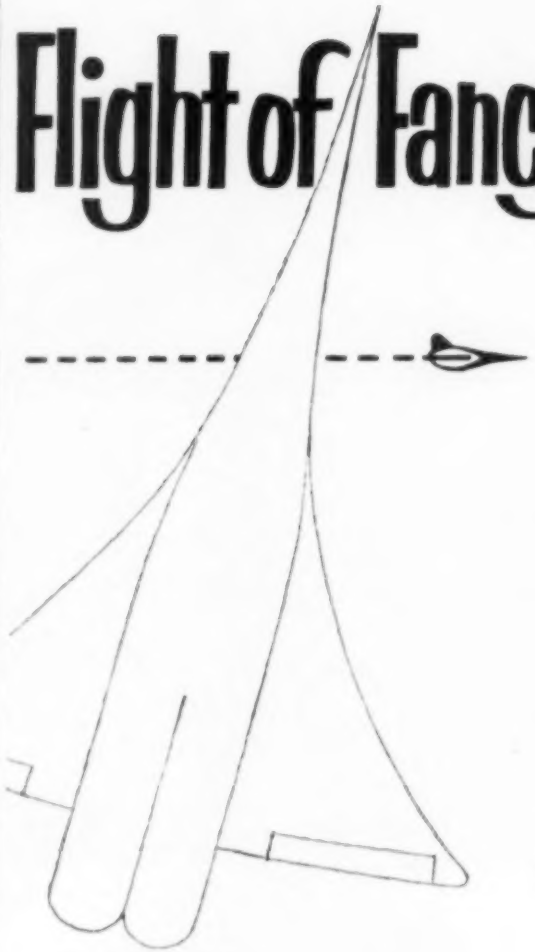

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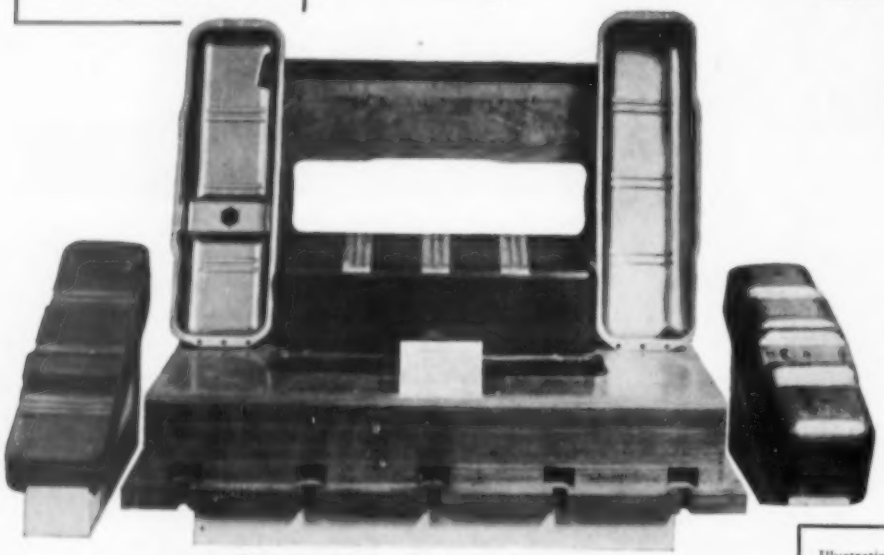

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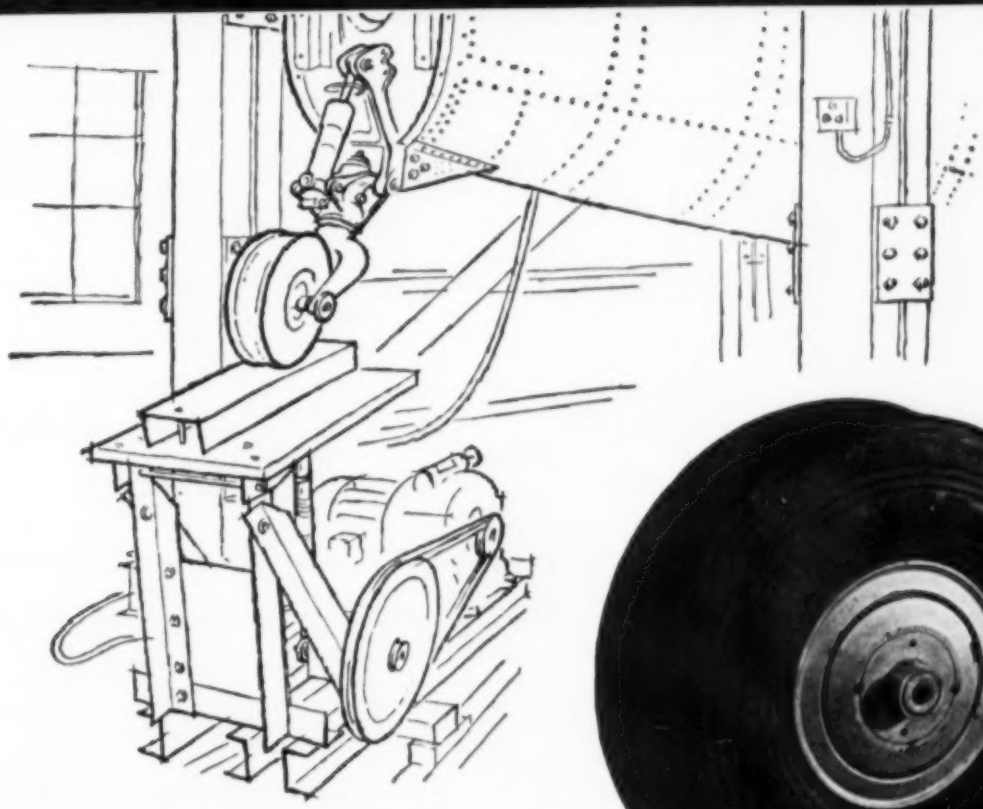

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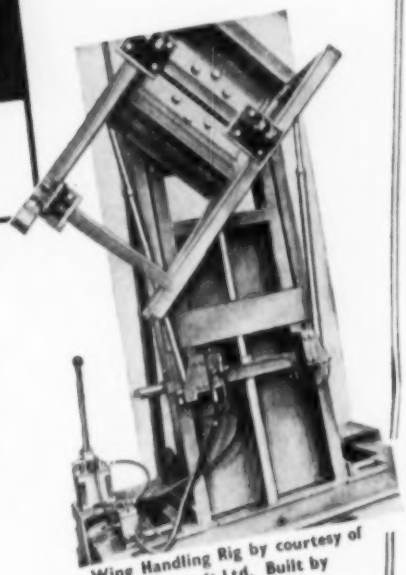

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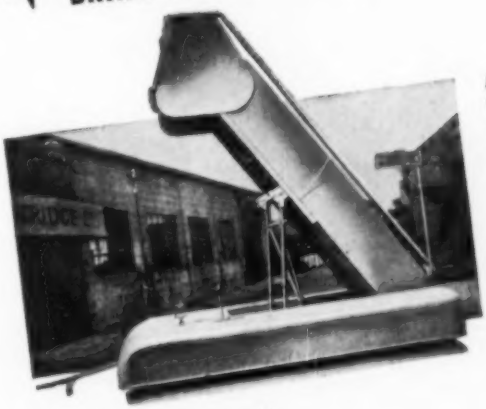

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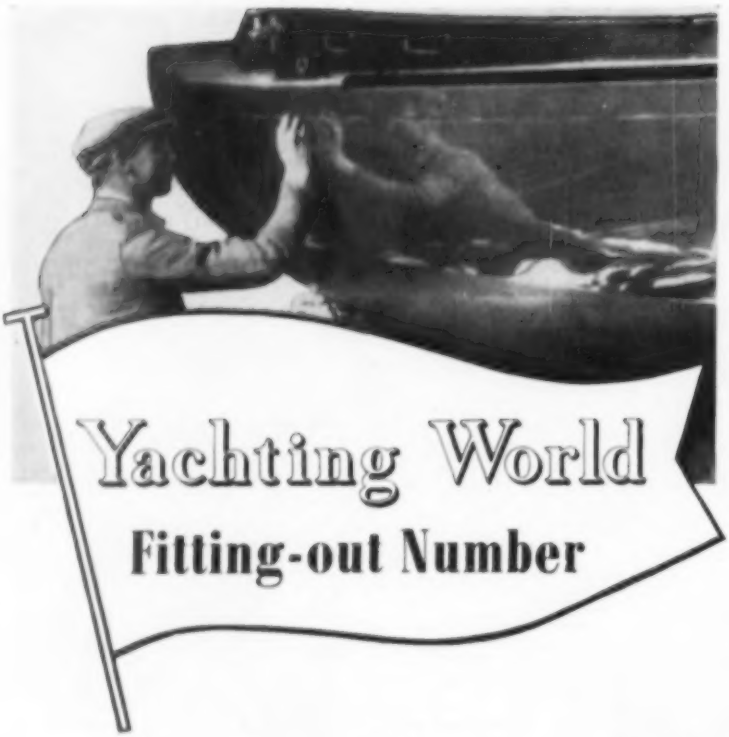

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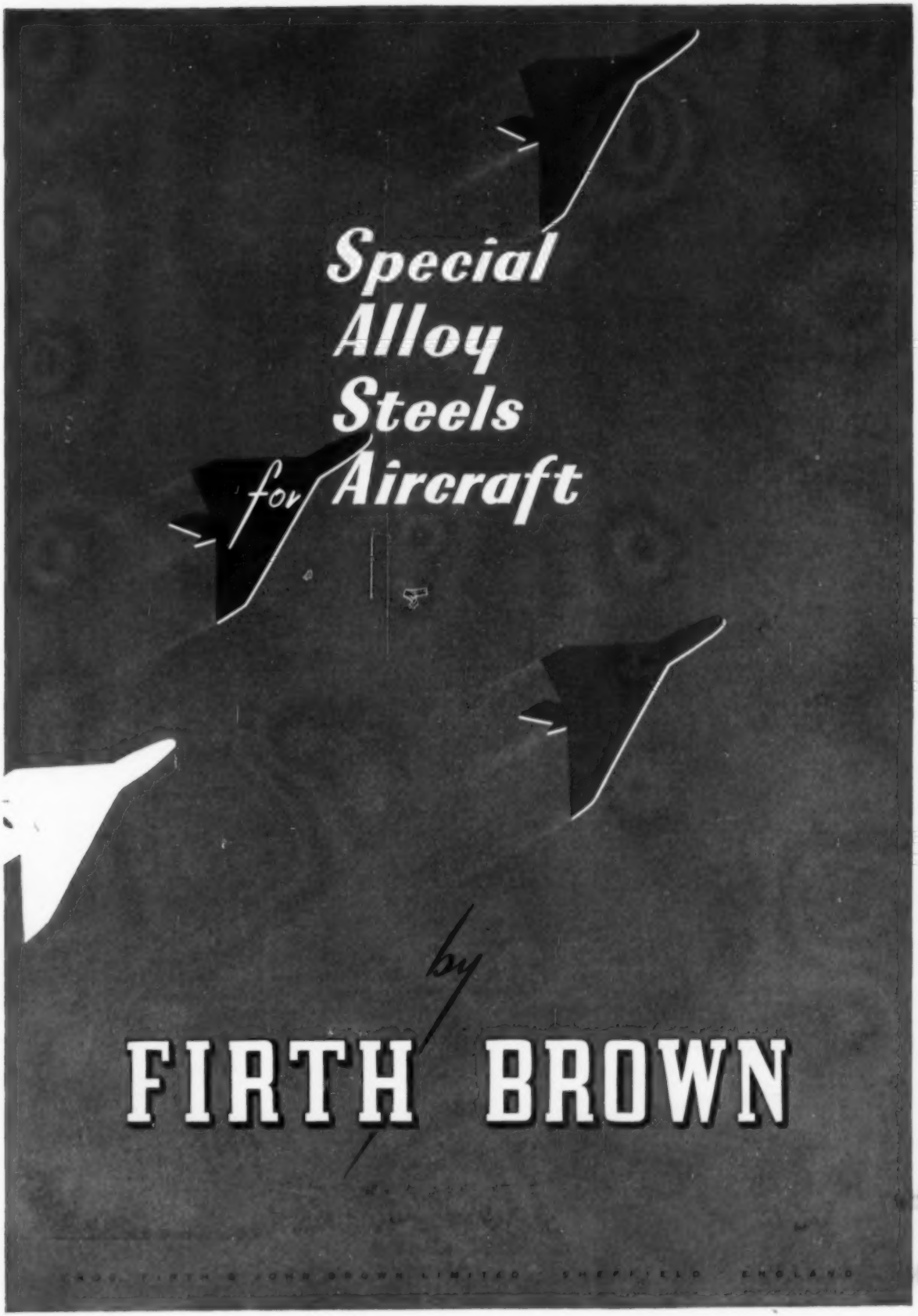
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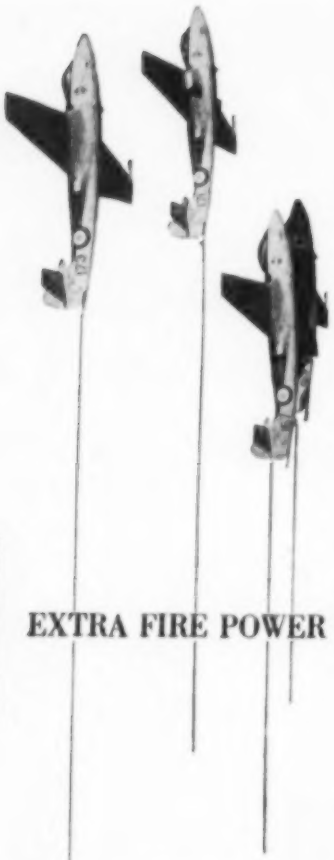

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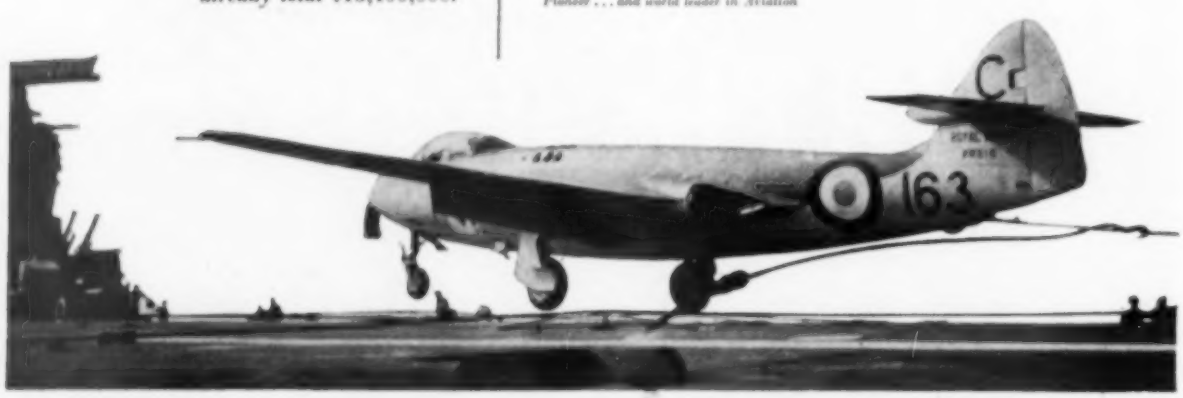

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Prejudice and Pride

THIS is the time of the year when Ministers and departments issue statements on supply and on defence, and memoranda on the Estimates for the three Services. Our remarks last week, made after a study of two important White Papers concerned with air defence had, unfortunately, to reflect a widely felt dissatisfaction; the state of affairs revealed was certainly not one to cause jubilation. The debates associated with the Estimates and other defence matters are now beginning to take place.

It appears to us that altogether too much party political bias has tangled into questions and answers about what ought to be straightforward matters of defence provisions and planning. Members of the public, regardless of their political colour, are getting tired of the sniping technical questions from partially briefed politicians and of cover-up generalizations in many of the answers they receive.

To ask technical catch questions out of their broad context (and knowing pretty well what the answers must be) simply to try to make political capital, is profitless to individuals, and especially so to the nation. From the point of view of security, it is irresponsible and can be harmful—a fact that has not escaped American notice.

There must be better ways of indicating genuine interest or alarm over matters of defence. One can imagine the surprise and flurry of activity in certain intelligence sections if a member of the Supreme Soviet rose publicly to ask about armament faults in Russian jet bombers, or performance shortcomings in a new fighter.

An examination of the course of events in chronological order does not reveal much of which the aircraft industry should feel ashamed. Generally speaking, when the requirement has been stated, and the money found, the goods have been delivered—though aircraft cannot be designed, built and perfected in three years. Having said this much, we would now refer readers to the summaries of the Air Force, Navy and Army Estimates statements, all to be found elsewhere in this issue.

Divested as it is of all rhetoric, histrionics or personal bias, the Air Estimates Memorandum reveals some good, solid progress. Particularly gratifying is the news of the new home radar chain, complete and largely underground. No doubt this has had some bearing on official statements regarding the superiority of our night fighter defences.

It is encouraging to know that Canberra bomber squadrons are at full strength, and that Valiants are being delivered. Hunters, as everyone must now be aware, are in squadron service; and the pilots, who are in the end the best judges of quality, are more than pleased with them. Excellent work is being done in Malaya by helicopters and light aircraft. Sycamores and Pioneers in particular have now proved themselves in action.

It is learned with pleasure that almost the whole of Bomber and Fighter Commands are now housed in good permanent accommodation. More airmen are serving on long engagements, and recruitment for Halton, Locking and Cosford is satisfactory. In spite of the remaining difficulties in obtaining sufficient radio and other engineering tradesmen, the position is encouraging, bearing in mind that the country is enjoying very full employment and high wages in many industries.

Good news for the air operators, especially the independents, is the continued growth of air trooping and the satisfactory reports on the work accomplished to date.

These references, it will be noted, are all to actual achievements, as distinct from plans nearing fruition. It is pertinent to recall that it was only three years ago—on March 26th, 1952—that the Government's plans for accelerating re-armament under the super-priority scheme were announced. The types named then were the Hunter, Swift, Canberra, Valiant and Gannet, and either the G.A.5 (now Javelin) or D.H.110.

The Royal Navy is much occupied with re-organization to suit the thermo-nuclear weapon age, but it can nevertheless also report solid progress with carriers and aircraft, and with the big three—or four—inventions for improving carrier aircraft operations.

It is neither unexpected nor without significance that the Army Estimates statement contains a number of references to aircraft. Air trooping and the work of helicopters overseas are again subjects singled out for special mention. With each year that passes the two senior Services come to require more of aviation.

FROM ALL QUARTERS

B.O.A.C. Eats Its Cake and Keeps It

NO one is more anxious than ourselves to see B.O.A.C., equipped with the best available aircraft, increasing its services and standards of operation.

Today's somewhat marginal position—the reasons for which are well known—should be very different in a year or two, when B.O.A.C. have in service new Comets and Britannias (than which there will be no better airliners) and American Douglas Seven Seas to help out in the meantime.

With present equipment, some of it on hire, the African and Australian services are holding their own; the North Atlantic services are for the time being at least as good as anyone else's; the South American services have unfortunately had to be withdrawn; and no B.O.A.C. aircraft yet cross the North American continent (beyond Montreal and Chicago) or the Pacific Ocean.

Last Saturday's announcement of an increased order for Britannias, to make the total 33, comprising 15 Mk 100s, eight Mk 300s and ten Mk 300 L.R.s, is very encouraging. The addition of 60 BE.25 turboprops to the order book makes the aircraft order doubly pleasing. The conversion of Proteus 300 L.R.s to BE.25 power when it is available (1958-59), is a comparatively simple task, involving days rather than weeks or months. The first 300 L.R.s with Proteus 755s will be non-stop London-to-New York machines with 90 passengers.

B.O.A.C.'s order for ten DC-7Cs—for delivery beginning late next year, and costing the dollar equivalent of no less than £13m—is approved on the understanding that these aircraft are resold for dollars when the L.R. Britannias come into service. The reason for this proviso is apparent, but, on consideration, seems to be only of limited importance; we should not be surprised to see it waived when the time comes. As we have indicated before, the 1958-59 purchaser (if one can be found) interested in second-hand, long-range, in-the-weather-altitude DC-7Cs, "at most, if not all, of their original cost," might instead be sold, at no greater cost and with greater advantage to both sides, ten new Britannias. It will be a case of one or the other, not both. It is likely that the extra capacity will be easy to absorb five years from now.

In passing, it may be mentioned that the Corporation will in a year or two's time be in the unique position of being able to assess on even terms the relative merits of the two competing British and American types. The DC-7C has first, of course, to be granted a British C. of A.—this after flying and obtaining American certification.

Airwork Atlantic: Inaugural Flight

IT is unusual for an aircraft, even on an inaugural flight, to receive three send-off ceremonies in succession, but this in fact was the happy lot of the first Skymaster freighter which opened the Airwork Atlantic freight service last Tuesday, March 1st.

The proceedings started on the Monday evening with receptions at London, Manchester, Birmingham and Glasgow, attended respectively by the Mayor of Westminster, Lord Mayor of Manchester, Lord Mayor of Birmingham and Lord Provost of Glasgow. The Lord Mayor of London had also instructed the operators to carry a letter of greetings to the Mayor of New York.

Loading started at London Airport at 7.45 a.m. on Tuesday morning, and at 9 o'clock Mr. J. A. Boyd-Carpenter, Minister of Transport and Civil Aviation, accompanied by the Parliamentary Secretary, Mr. J. D. Profumo, arrived to inspect the Airwork freight shed. The Minister also boarded the aircraft and met the crew before the take-off at 10 a.m. At 11.30 there was a ceremonial loading by the Lord Mayor of Manchester at Ringway airport, and the aircraft then proceeded to Prestwick for a second ceremonial loading, performed by the Provost, at 1.30 p.m.

After crossing the Atlantic the Skymaster was due for a reception at New York International Airport (Idlewild), and a further celebration was scheduled at the Wings Club, New York.

Sir Archibald P. Hope, joint managing director of Airwork, spoke of the tremendous interest shown by agents on both sides of the Atlantic in this new British service, and he added that more people were beginning to realize that delivery by air was a normal and often inexpensive method of getting their goods to the place where they were required. His company was watching the market with a view to possible increase in frequency in the future. The eventual object was to have a cargo machine leaving London after the close of business every day and arriving in New York before the opening of business on the following day.

A truly mixed cargo was carried on the first flight. It included a pair of George II mahogany chairs consigned by a British antique firm to a New York private purchaser, a Winston Electronics camera capable of .000001 sec exposure, for delivery to the U.S. Government, a 3½-cwt cigarette-making machine, model motor cars, Scottish woollens, ship, motor car and machine-tool spare parts, watches, jewellery, silverware, musical instruments, photographic apparatus, ceramics, glassware, sweets and chocolates, Irish linens, accounting machinery, leather goods, furs, hosiery and hats.

In place of the steward or stewardess of a passenger machine, Airwork Atlantic carry a cargo courier (on this occasion Mr. Brotherston) whose job it is to facilitate correct loading and off-loading, and to see that any special instructions of the forwarding agents are carried out.

There will be a link-up between Airwork Atlantic and the company's Continental cargo service from Frankfurt, Basle, Zurich and Milan. Later in the year Airwork expect to take delivery of DC-6As to replace the Skymaster on the North Atlantic air freight service. The first service was flown with a DC-4 chartered from Trans-Ocean Air Lines and manned by a T.O.A.L. crew, but carrying an Airwork crew under training.

The T.O.A.L. crew of four was headed by Capt. F. G. Kendall, and that of Airwork by Capt. R. J. Covington. Three cargo couriers were carried, and the limiting Atlantic load of 15,500 lb was lifted—3,000 kg from London, 3,000 kg from Ringway, and 1,500 kg from Prestwick. The DC-4, N-47623, had "Taloa" painted on the tail (with red and yellow rudder) and "Airwork" inscribed above the windows. It was the aircraft used in the film *The High and the Mighty*, and at one time belonged to President Peron.

In about six weeks' time the British crews will take over. Airwork will also introduce the DC-6A on the route, the aircraft being chartered from Slick Airways pending delivery of Airwork's own Liftmasters.

British Pilotless Bomber?

IT is reported by *Aviation Week* that in about three months tests will begin at Woomera on a new British pilotless rocket bomber prototype. Principal object of the tests, it is said, will be improvement of accuracy and range—the latter being in the order of 500 miles. One design, which is considered promising, has, according to our American contemporary, a narrow (70-80 deg) delta wing.

Comet 2s for Woomera Shuttle

A WEEK after the official announcement that modified Comet 2s were to be bought for R.A.F. Transport Command came a disclosure of one of their duties.

In his Memorandum accompanying the Air Estimates (summarized on pages 260-261) the Secretary of State for Air says that the Comets "will be put into regular use on the military transport service to Woomera, Australia. This service is becoming of increasing importance and is one in which we hope to derive great benefit from the Comet's speed.

Transport Command already operates a service—using, principally, Hastings aircraft—to and from the Woomera rocket range, and demands on it are steadily increasing as the tempo of development is stepped up. With the aid of flight refuelling, a Comet could make the journey in well under 24 hours.

Sound Approach for Fleet Air Arm

A NEW device has been developed by the Royal Navy to contribute towards safety of carrier landings by giving the pilot audible indication of his approach speed. Known as Audio, and heard as a background note through the headphones, it augments, and may supersede, the visual reflected tri-colour light signals on the windshield and lately used in conjunction with the mirror sight. This visual aid has not always proved satisfactory under adverse light conditions.

Audio is officially described as "relatively simple, accurate to within a quarter of a knot, and made in two parts (a sensing unit attached to the pitot head and a sound-producer that is in effect a two-note electric organ) which need not be placed in "gold-plated" space in the aircraft."

Credit for the device is given to Surgeon Lt-Cdr. W. H. B. Ellis, A.F.C., M.B., B.S., R.N., who is also a qualified pilot attached to the R.A.F. Institute of Aviation Medicine. He worked with Mr. A. A. Burrows, of the Institute scientific staff.

In the first place, after the acoustic method had been tentatively selected, a laboratory experiment of the precision-flying type was carried out, and of 48 subjects taking part (half of them pilots) 26 gave the most accurate performance with the Audio air speed, 15 with flashing lights, and only five were best when using a conventional A.S.I.

A trial installation was then made and tested in a Sea Hawk, and observation of the pilot and his reactions (a camera was installed in place of the gun-sight to record eye movements) indicated that with the Audio A.S.I. few visual references need be made to the conventional instrument and that a pilot appears to have more time to look round and appreciate the area of approach.

***LETHAL SEGMENTS** of the fuselage of the Lockheed F-94C Starfire two-seat all-weather fighter, each containing six firing tubes for Mighty Mouse air-to-air rocket projectiles. The firing ports are normally closed by the retractable panels, seen here as an annulus round the nose.*

A prototype Audio A.S.I. installed in a Sea Hawk was next used for extensive trials, including deck landings on H.M.S. *Albion*, in conjunction with the mirror landing aid. Thirty-five pilots who reported on the system clearly indicated its efficacy. The sound code was simple and could be learned in a few minutes. The signals were arranged to be heard in the pilot's headphones only below the speed for undercarriage and flaps down.

There are no valves to go wrong, and serviceability of the prototype equipment has been 100 per cent to date. The signals can, if desired, be transmitted by one of the aircraft's radio sets, so that a check on approach speeds can be made by a flying instructor or a control officer.

The pilot's controls consist of an on/off switch and a volume rheostat. In early production models there will also be a three-position selector to move the speed datum. It is possible that, in the future, the Audio system may be developed to indicate angle of attack instead of air speed. A Sea Hawk squadron is to be equipped with Audio in June this year.

50,000 Talk-downs

ON February 22nd London Airport logged the 50,000th talk-down landing made since the G.C.A. equipment was introduced there in March 1947. The aircraft which made the 50,000th landing was a T.W.A. Constellation piloted by Capt. E. Pretsch. Because of the high traffic-density and, frequently, poor weather conditions, it is probable that more use is made of G.C.A. facilities at London than at any other international airport. A L.A.P. record was established in January, when 2,425 talk-downs were successfully completed; this figure represents some 80 per cent of the total number of landings there for the month. Operation of the system was described in *Flight* of April 16th, 1954.

Atlas and Snark

INFORMATION officers of the U.S.A.F. have not, until recently, been allowed to use the name Atlas to describe a weapon. Their stock answer was that Atlas was a Greek god who held up the world. Now General Nathan Twining, U.S.A.F. Chief of Staff, has officially told reporters in Washington that work on Atlas—an inter-continental ballistic missile, against which there is no known defence—is "just getting going." The missile is reputed to have a range of 5,000 miles and to have an accuracy-radius of 20 miles. General Twining has also officially disclosed that Snark, a long-range pilotless bomber, has already been tested. This weapon, too, is believed to have a range of about 5,000 miles, though at subsonic speed, and is reputed to use a celestial-navigation system.

Senator Jackson, a member of the Senate Armed Services Committee on the Air Force programme, has said of the long-range missiles: "Whoever gets the missile first will upset the present so-called atomic stalemate. The atomic stockpile only has meaning so far as there is ability to deliver it better than a potential enemy."

Two Appointments

IT was announced on Monday by Folland Aircraft, Ltd., that S/L. L. M. Whittington, A.F.C., has joined them as assistant to S/L. E. A. Tennant, their chief test pilot. "Dick" Whittington was, until recently, an assistant experimental test pilot with English Electric.

News of another move in the industry comes from Belfast, where Short Bros. and Harland, Ltd., have appointed Mr. D. W. Bottle, B.Sc., A.C.G.I., A.M.I.Mech.E., A.F.R.Ae.S., to the post of chief aerodynamicist. He was formerly with the R.A.E and the A. and A.E.E.

R.A.F. Servicing Inquiry

THE Air Ministry announces that the Secretary of State for Air, Lord De L'Isle and Dudley, V.C., has appointed a committee with the following terms of reference:—

"With the object of obtaining economy with efficiency, to review the arrangements current for the servicing and repair of aircraft and other technical equipment throughout the Royal Air Force, including methods and procedures relating to the holding and distributing of equipment generally, with a view particularly to ensuring the maximum economies in skilled manpower."

The chairman will be Air Chief Marshal Sir Leslie Hollinghurst (Ret.) and the vice-chairman Mr. F. C. Cooper, who is managing director of Schweppes, Ltd. The other members will be: Mr. James Crawford, president of the National Union of Boot and Shoe Operatives, and deputy chairman of the British Productivity Council; Air Marshal Sir Owen Jones, Controller of Engineering and Equipment, Air Ministry; A.V-M. L. J. V. Bates, Director-General of Equipment, Air Ministry; Mr. F. R. Howard, Air Ministry; Mr. S. C. Robbins, Ministry of Supply; and A. Cdre. F. Pearce, Director of Manning, Air Ministry. Mr. F. C. Fayers, Air Ministry, will be secretary.

The decision to appoint the Committee is referred to in the Air Ministry's reply to the *Eighth Report from the Select Committee on Estimates, Session 1953-54*, which recommended an investigation into the system of maintaining, storing and repairing equipment with a view to effecting economies.

R. J. Goodman Crouch

WE learn with regret of the death, on February 24th, of Mr. R. J. Goodman Crouch, O.B.E., F.R.Ae.S., F.R.S.A., A.F.I.Ae.S., well known in the aircraft industry and, in sporting aviation, as a former Royal Aero Club handicapper and committee-member. He was head of the technical division of Burnley Aircraft Products, Ltd., and was shortly due to leave for Canada in order to take up an appointment on behalf of the company. He was 63 years of age.

His career, which was in aviation from very soon after the time he left University College, London, was of an exceptionally varied nature. Before World War I he was with the Breguet company in France, and in 1915, having joined the R.N.A.S., he was occupied upon work with small non-rigid airships. In 1916 he went over to heavier-than-air craft and, after commanding the R.N. air station at Dunkirk, served in France. Later he was engaged on the investigation of aircraft designs, work which he continued on transfer to the R.A.F.

After the war, and as a civilian, he held a number of increasingly responsible Air Ministry posts, some in London and others at Farnborough. From 1922 to 1928 he was head of the Airworthiness Department at the R.A.E.

In 1929 he went to the United States and entered industry, eventually becoming president of a group which included Crouch-Bolas, Inc., the Dayton Engine Co., American Aeronautical Corp. and Pheasant Aircraft Co. His partner in Crouch-Bolas was another Englishman, Harold Bolas, one-time chief designer to George Parnall, and between them they evolved a successful "tilted slipstream" high-lift device.

Returning to this country at the request of the Admiralty in 1937, he resumed Government work, first at the Air Ministry and then at the Ministry of Aircraft Production, where he became Deputy Director of Labour, with responsibility for man-power in the airframe and engine industries.

His business interests before he joined Burnley Aircraft Products in 1953 included the managing directorship of two companies, Crouch (Engineering), Ltd., and Wilkinson (Constructions) Ltd.

THE AIR ESTIMATES

Important Points from the Air Minister's Memorandum: Cost Figures Summarized

AS has become customary, the Air Estimates* for the year (1955-56) which were presented in Parliament last week, were accompanied by a Memorandum† submitted by the Secretary of State for Air. Taken in the order in which they appear, the following figures, facts and reports of progress emerge from Lord De L'Isle and Dudley's memorandum:—

The net total of Air Estimates for the year is £513,900,000, which represents a net increase of £22,260,000 as compared with the previous year. This allows for the receipt of £26,500,000 out of the aid given by the U.S.A. towards the defence of the United Kingdom, a figure which compares with £45,360,000 for last year and consists of £16,500,000 for "special aircraft purchase" and a first instalment of £10,000,000 for aircraft and equipment to be bought in this country by the United States Government, but to be made available to the R.A.F. Thus, the total figure for Air Estimates and American aid is £540,400,000, against last year's total of £537,000,000.

Commenting that the difference between the totals was small, the Secretary of State for Air nevertheless pointed out that the gross expenditure on aircraft and armament was expected to be about £32,000,000 more this year and that greater provision for radio and radar equipment had been made, but that less would be spent on petrol and oil (as a result of a reduction in the price of fuel to the R.A.F.) and clothing.

Although the average strength of the Service would be lower, pay improvements and additional National Insurance contributions would result in £3,000,000 more being required. Payments to civilians would increase for similar reasons. Of the £19,000,000 provided under works for the United States Air Force, some £15,000,000 would be recovered.

V-bomber Objective.—Following this financial preface, the Air Minister referred to the role of the Royal Air Force. He said: "The primary task which now confronts the R.A.F. is to build up the V-bomber force with its nuclear potential to a state of high efficiency and preparedness. Thus the R.A.F., together with the U.S.A.F., will provide the main deterrent to aggression, since it is primarily by the threat of overwhelming nuclear striking power that an aggressor will be deterred."

Reference was next made to the selection of crews, provision of bases, and perfection of methods of operation to suit the V-bombers, which would begin to come into service during the next 12 months. In the meantime, the Canberra force would be at its full strength.

The Minister said that the expansion of Fighter Command had been completed, but that the proportion of all-weather fighters would grow, the squadrons receiving their Javelins during the year. Other squadrons were being re-equipped with Venom night fighters. The first squadrons of Hunters had been formed and, although the rate of delivery had been disappointing, re-equipment was now proceeding steadily.

Future of the R.Aux.A.F.—The Memorandum included an important statement on the immediate future of the Royal Auxiliary Air Force, the organization of which was being adapted to meet new conditions. The new scheme differs from that provisionally notified. Each squadron is to be linked with a regular fighter squadron, and pilots who have the requisite experience and aptitude are to be given the opportunity to train on the high-performance aircraft with which the associated squadron is equipped. They will thus be able to provide an immediate reserve of individual pilots behind their regular squadrons. In addition it is now proposed that Auxiliary squadrons shall retain their full establishment of Meteor and Vampire aircraft, besides the training flight, and continue to supplement as fighting units the defence against those other forms of air attack which might constitute a serious threat to this country. This arrangement, which makes the best use of our resources under the new conditions, is to be reviewed from time to time in relation to the threat.

Intruder Canberras for 2nd T.A.F.—Referring to 2nd T.A.F., the Minister said that effectiveness would be increased by the strengthening of the reconnaissance force in numbers and quality by the introduction of more photographic-reconnaissance Canberras [as reported in the *Defence Statement* of the previous week] and night-interdictor Canberras. He added that Coastal Command would be strengthened by the formation of special flights equipped with Seamews for short-range anti-submarine reconnaissance.

Mention was next made of the good work done by the Far East Air Force in Malaya. In particular, helicopters and light aircraft had done excellent work in troop-carrying, casualty evacuation and transporting supplies, and Pioneers had helped maintain forts established in the jungle.

Overseas-reinforcement Exercises.—Of great significance was a reference to exercises in rapid reinforcement overseas. In the coming months fighter and bomber squadrons will carry out special exercises, frequently supported by Transport Command. In due course, there is to be a regular movement of V-bomber aircraft to the Middle East and Far East.

The Minister said that Vickers 1000s ordered for Transport Command were designed to increase mobility for the strategic reserves of both land and air forces. In addition, and pending the delivery of these aircraft, Comet 2s, modified and strengthened, were to be put into regular use on the military transport service to Woomera. The first Beverleys were expected to reach squadrons during the year.

Under the heading of training, it was noted that all schools were now working on the new system under which a pilot passes from Provost to Vampire before being awarded his wings. Standards had been markedly higher than under the old system. Flight simulators would come into use this year as a training aid for the V-force.

Efficient Use of Man-power.—Despite expansion and re-equipment with more complex types of aircraft, it had been found possible to reduce the man-power figures from the 1953 peak of 277,100. The Estimate for April 1st, 1955, was 259,300, and for April 1st, 1956, 254,000. The reduction was partly due to the passing of the peak in flying training requirements, and to re-deployment in the Middle East, but it also reflected progress in improving management and organization.

It was encouraging to note from the Memorandum that the numbers of airmen serving on engagements of 12 years or more rose from 35,000 in January 1954 to 40,000 today. The improved pay and allowances announced in March 1954 have clearly been an encouragement. Contrary to his forecasts last year, said the Minister, the proportion of National Servicemen had, instead of decreasing, remained steady at about 26 per cent. During the next financial year, 41,000 National Servicemen would have to be entered, and this would increase the proportion to nearly 30 per cent.

The Minister indicated that establishments in the aircraft engineering trade group had been filled by giving advanced training to airmen serving on short engagements. By this measure, it was expected also to make good the deficiencies in the armament and instrument trade groups by April. Although much larger numbers of tradesmen in these groups were signing-on for engagements of 12 years or more, it would take very many years at the present rate before any appreciable relief could be expected from the heavy and expensive task which this training imposed upon Technical Training Command.

Training Radio Engineers.—The most difficult problem was in the radio engineering trade group. Training capacity had been expanded to take all the young men capable of absorbing training, including National Servicemen. Since the training took about a year, National Servicemen could, however, give only one year's productive service.

Remarking that the nuclear threat had intensified the need for the highest possible state of readiness, the Minister said that both in the air and on the ground the reserves required must be kept fully trained, know their war stations and be able to move direct to those stations. The numbers of aircrew required for immediate reinforcement of the front-line squadrons in war had been calculated. Suitably qualified serving aircrews not at present in squadrons had been selected and were being given such refresher training as was necessary to keep them up to full operational standards.

Points of particular interest under the headings of "Works" and of "Land" were references to the provision of runways for the operation of V-bombers and the new fighters, and of special technical buildings, pressure refuelling systems and explosive storage to accord with present-day requirements.

Underground Radar Installations.—The largest single project at home had been the reconstruction of the radar chain. This now covered the whole of the U.K. Hundreds of new installations had been built and vital parts of the system had been put deep underground and protected by massive thicknesses of concrete. The extent of the work on any one underground installation was not much less than that involved in building a new tube station.

*"*Air Estimates 1955-56," H.M. Stationery Office, price 8s.*

†"*Memorandum by the Secretary of State for Air to Accompany Air Estimates 1955-56," H.M. Stationery Office, price 6d.*

There were now 18,000 permanent and 2,000 temporary married quarters as compared with a total of 6,700 at the end of the war. A further 2,000 permanent quarters were under construction.

As a result of a review, the Secretary of State hoped that, with the help of the Ministry of Agriculture, he would be able to dispose of a large number of the smaller disused airfields.

Compared with nearly 6,000 requisitioned house properties held at the end of the war, the Ministry today held only 31 and, said the Minister, it should not be very long before they had all been released or bought or rented.

New Transports for Air Trooping.—On the important subject of air movements, it was stated that about 56 per cent of Service passengers had been carried by air, compared with 54 per cent in 1953-54 and 49 per cent in 1952-53. A contract for a regular air trooping service between the U.K. and the Far East was now in operation. Increased use had also been made of air movement for the carriage of priority freight.

In all, reported the Secretary of State, some fourteen million miles had been flown during the year by R.A.F. and chartered aircraft engaged on air trooping and air freighting tasks. Progress was also being made towards the introduction of more modern types of aircraft; Viscounts would, it was hoped, be introduced shortly by independent operators for medium-range work and in about three years' time Britannias should similarly be in trooping service to the Far East.

The Secretary of State for Air concluded his Memorandum by referring to meteorological developments and the centenary celebration, this year, of the Meteorological Office.

THE VOTES

AS most readers will know, the estimates are divided into "votes." These, eleven in all, are briefly referred to below under their individual headings. The sums quoted represent the gross estimate for 1955-56 with, bracketed after each, the equivalent figure for 1954-55. The net increase or decrease is then stated. In the tabulated abstract contained in the printed estimates both gross and net estimates are quoted, the difference being represented by Appropriations-in-aid.

There is, in addition, Vote A, which fixes the number of officers, airmen and airwomen who may be maintained during the year. The Royal Air Force total of 260,000 is made up of 26,200 officers and 233,800 airmen and airwomen. Princess Mary's Royal Air Force Nursing Service totals 500 officers. The Women's Royal Air Force has 600 officers and 6,900 airmen and airwomen. Others concerned in this vote are local forces abroad totalling 60 officers and 3,140 other ranks and other Commonwealth air forces with 340 officers and 460 airmen and airwomen. The grand total of those included under Vote A is 272,000.

Vote 1: Pay, etc., of the Air Force.—£91,960,000 (£89,180,000). The net increase of £2,610,000 is mainly due to improvements in the rates of pay of all ranks and the provision of local overseas allowances for a large number of families abroad. Employers' insurance contributions are also at an increased rate.

Vote 2: Reserve and Auxiliary Services.—£2,802,000 (£2,181,000). This vote shows a net increase of £530,000, mainly due to the provision of reserve pay to a large number of class E Reserve airmen. A larger number of R.A.F. Reserve personnel are also receiving ground training. Total strengths of Reserve and Auxiliary forces for 1955-56 (and 1954-55) are: Reserve officers, 6,900 (3,900); P.M.R.A. officers, 100 (100); airmen and airwomen of classes E, H and K, 210,000 (175,000); R.A.F.V.R. officers, 8,700 (8,500); R.A.F.V.R. airmen and airwomen, 4,300 (6,500); R.Aux.A.F. officers, 1,500 (1,300); R.Aux.A.F. airmen and airwomen, 9,500 (10,000). The women's R.A.F.V.R. comprises 100 (100) officers and 300 (500) airwomen, and the women's R.Aux.A.F., 150 (150) officers and 2,500 (3,100) airwomen.

Vote 3: Air Ministry.—£4,676,000 (£4,347,000). The net increase of £300,000 in this vote, for salaries of civilian staff of the Air Ministry and including the headquarters staff of the Meteorological Office, reflects improvements in pay and the provision of 123 additional staff. The clerical staff of the department of the Air Member for Supply and Organization has been increased by 55.

Vote 4: Civilians at Outstations.—£35,148,000 (£32,463,000). Appropriations-in-aid of £4,898,000, mainly from the U.S.A.F., are £1,005,000 higher this year; thus the net increase is £1,680,000. Improvements in pay, and the higher number of civilians engaged for the U.S.A.F., are chiefly responsible for the increase.

Vote 5: Movements.—£14,930,000 (£13,230,000). The net increase of £1,200,000 is mainly due to the greater use of civil aircraft to move personnel to and from commands abroad and to increased movement of stores by rail and sea. Movements by Service vehicles are not included under this vote, nor are deliveries of stores from contractors. Personnel covered include Reserves, Auxiliaries and civilians.

Vote 6: Supplies.—£91,830,000 (£102,910,000). Provision is made under this vote for food, solid fuel, electricity, gas and water and—a major item— liquid fuel and lubricants. The net decrease of £9,840,000 in the latest vote is mainly due to reductions in the price to the R.A.F. of aviation fuel.

Vote 7: Aircraft and Stores.—£292,000,000 (£267,000,000). By far the largest vote, and showing an increase of £27,860,000, this vote provides for aircraft in particular (£186m), for armament and ammunition (£37,400,000), for radio and radar (£31,600,000) and for other items such as instruments, photographic equipment, vehicles, clothing and medical stores. The increase in the vote this year is due to greater supplies under the three main items listed above. Aircraft alone are increased by £30m. Of the total estimate under this subheading airframes account for £80m, spares and components for £26m and engines for £80m.

Vote 8: Works and Lands.—£69,600,000 (£70,700,000). Reduced requirements account for the £1m reduction in this vote, which is concerned with airfields (construction and upkeep), workshops, storage buildings, roads and so on.

Vote 9: Miscellaneous Effective Services.—£8,700,000 (£8,790,000). A considerable increase in appropriations-in-aid results in a net decrease in this vote of £1,600,000. Provision is made for telecommunication and postal services, maps and charts, educational and other training outside the R.A.F., and compensation for loss and damage. The appropriations-in-aid of £4,330,000 are mainly due to recovery of charges for training personnel of other departments and governments.

Vote 10: Non-Effective Services.—£5,907,000 (£5,400,000). The net increase of £520,000 is due to the growth of retired pay, pensions and gratuities which, together with awards and compensation, comprise the provisions under this vote.

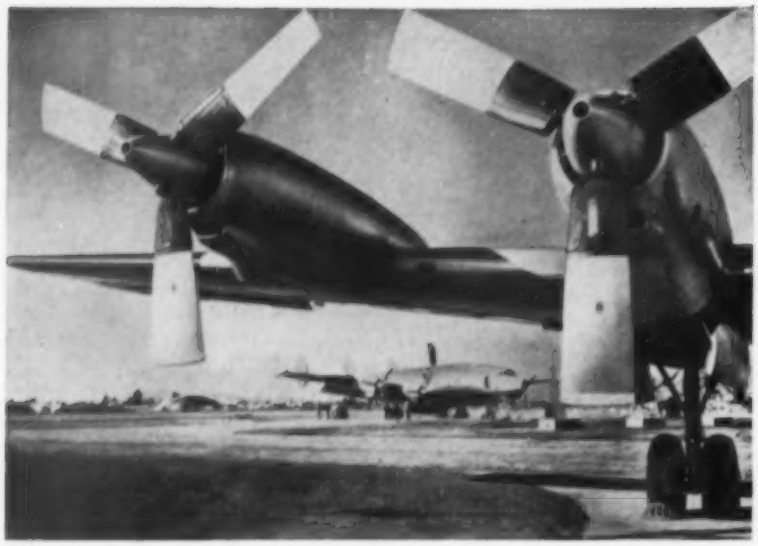
Vote 11: Additional Married Quarters.—£3,800,100 (£4,000,100). The net estimate for this vote is only £100, the remainder being covered by appropriations-in-aid of £3,800,000. The Armed Forces (Housing Loans) Acts, 1949 and 1953, refer.

Appendices deal in detail with pay and allowances of officers, airmen, and airwomen, with salaries and wages of civilian staff and with the staffs of certain special establishments. Reference is also made to medical, educational and meteorological services.

Naval Estimates Statement: p. 265. Army: p. 264

NUCLEAR POTENTIAL: THE VICKERS-ARMSTRONGS VALIANT B.1

In the foregoing account of the Air Estimates it is recorded that the Air Minister announced the primary task now confronting the R.A.F. as that of building up the V-bomber force, with its nuclear potential, to a state of high efficiency and preparedness. Illustrated is a Vickers-Armstrongs Valiant B.1, fresh from the production line. Machines of this type will equip the first R.A.F. Valiant squadron now forming at Gaydon, in Warwickshire.



***FOCUS ON AIRSCREWS:** With ever-mounting powers being taken from new turboprop units, the matter of airscrew design becomes one of pressing importance. Seen here are the 2ft-wide cuffed blades of the 16-ft screws being tested on the 5,600 h.p. Pratt and Whitney T34 turboprops of Lockheed's R7V-2.*

HERE AND THERE

Aircraft Atomics

SPEAKING at last week's annual dinner of the Institute of Petroleum, Mr. Geoffrey Lloyd, Minister of Fuel and Power, made a reference to atomic-powered submarines. A subsequent speaker was Mr. Lincoln Gordon, Minister of Economic Affairs at the U.S. Embassy in London, and he remarked that Mr. Lloyd "might have mentioned also that there is some very advanced work with atomic power going on in the aircraft industry also."

Siam Shows the Way

IN a leading article a month ago *Flight* said: ". . . a police force worthy of the label of 'modern' will need a helicopter fleet within the next few years in addition to its cars, motor cycles and patrol boats." On this showing, Siam's police are already making most Western police forces look distinctly out of date: they have just ordered four Hiller 12-B helicopters to supplement their fleet of 11, used for traffic and law enforcement, border control and transport of officials. Altogether, Siamese Government departments will now operate 20 Hillers.

Short-landing Mistral

A GROUND run of about 220 yards is claimed for an experimental development of the S.N.C.A.S.E. Mistral (Hispano-Suiza Nene) now on test with a skid-type undercarriage, installed by S.N.C.A.N. The gear has been developed by M. Renollaud, a director of the D.O.P. concern, and its eventual application to high-speed fighters is foreseen. Small rollers fitted to the skids facilitate ground handling. The nosewheel is of greater diameter than normal.

For Fast Beaching

A NEW mobile cradle developed by Convair for its R3Y Tradewind turboprop flying-boat is said to cut beaching time from about an hour to less than ten minutes; furthermore, only four men are needed for the operation instead of at least fifteen. Mainly of aluminium construction, the cradle weighs about 25,000 lb yet can be dismantled for air-lifting by a Tradewind itself. There are two large pontoons which, once in the water, are submerged, allowing the aircraft to taxi free. The eight large wheels have power steering and braking, and outboard engines are fitted for manoeuvring on the water.

Test Pilot Honoured

THE Queen's Commendation for Valuable Service in the Air has been awarded to Fairey test pilot Peter Twiss "for services when an aircraft, undergoing tests, sustained damage in the air." This relates to an incident at Boscombe Down on November 17th last, when Twiss successfully landed the F.D.2 supersonic research delta without engine power. The same issue of *The London Gazette* announces the award of the Queen's Commendation to two pilots of Cathay Pacific Airways (details: page 282).

ABOUT AIR TRANSPORT

NEXT week's issue of *Flight* (Friday, March 11th) will be the annual "COMMERCIAL AVIATION (World's Airlines and their Equipment)" Number. Considerably enlarged, it will contain articles of interest and value to all who are concerned with civil air transport. Features will include a review of current commercial aircraft, British and foreign, a directory of the world's airline operators and an article showing the effect of airworthiness requirements on transport design. The specially contributed views of aircraft constructors of four nationalities will also appear in this issue.

V.T.O. in France

ILLUSTRATED on this page is a V.T.O. rig which is being used by S.N.E.C.M.A. in the development of an annular-wing *coléoptère*. Its first vertical flight was made on March 31st, 1954. Remotely controlled, the unit has a boosted S.N.E.C.M.A. Ecrevisse pulsejet, and the proposed annular wing is replaced, as will be seen, by a framework, the aerodynamic effects of the wing being negligible at the low take-off and landing speeds now involved. Control is achieved by "action on the propulsive jet" and the cables seen are merely safety measures. S.N.E.C.M.A. are known to be working, in conjunction with M. von Zborowski, on designs for annular-wing V.T.O. intercepters built to the "ramjet/annular wing" formula, and present experiments are directed towards the running of gas turbines in the vertical position; development of jet controls; artificial stabilization; and jet compensation of gyroscopic moments during low-speed flight.

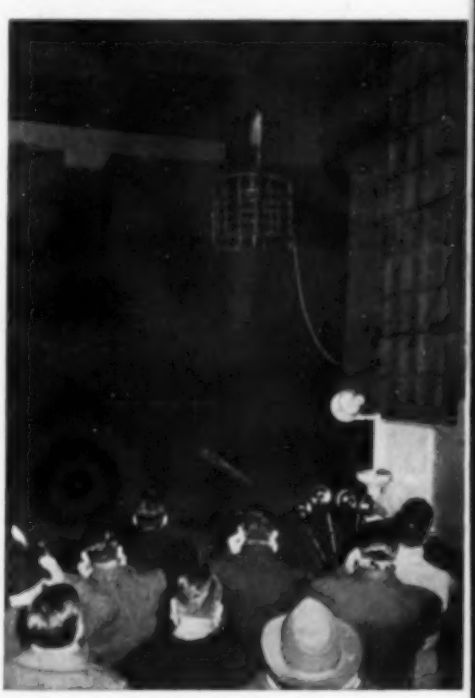
***NOISES OFF:** Observers stop their ears as the SNECMA V.T.O. rig (see item above) gets going in a corner of its test chamber.*

New Bell Army Helicopter

A CONTRACT is expected by Bell Aircraft for the development of a new light helicopter for casualty evacuation, general utility flying and for use as an instrument trainer. Designated Model 212 by the company, the new machine is believed to be a developed version of the H-13. The contract results from a design competition, and the 212 is the first completely newly designed helicopter offered by Bell to the Army. It will have a payload of 800 lb, cruise at 100 kt, and have a hovering ceiling of 6,000ft and a rate of climb of 1,500 ft/min.

Control-line—by a C-in-C.

GUEST of honour at the annual dinner of the Northern Heights M.F.C., held in London last Saturday, Air Marshal Sir Dermot A. Boyle, A.O.C-in-C. Fighter Command, made an amusing reference to the difficulty of placing an airfield at the club's disposal for model flying. "Unfortunately," he said, "and contrary to public opinion, we work at week-ends, so things would be rather difficult—I, too, have some highly expensive devices which I'm supposed to control, and I can't control them either." The Club, however, will have the use of a Technical Training Command station—Halton—for its gala day on June 26th.



ROTOL

Propellers and Equipment

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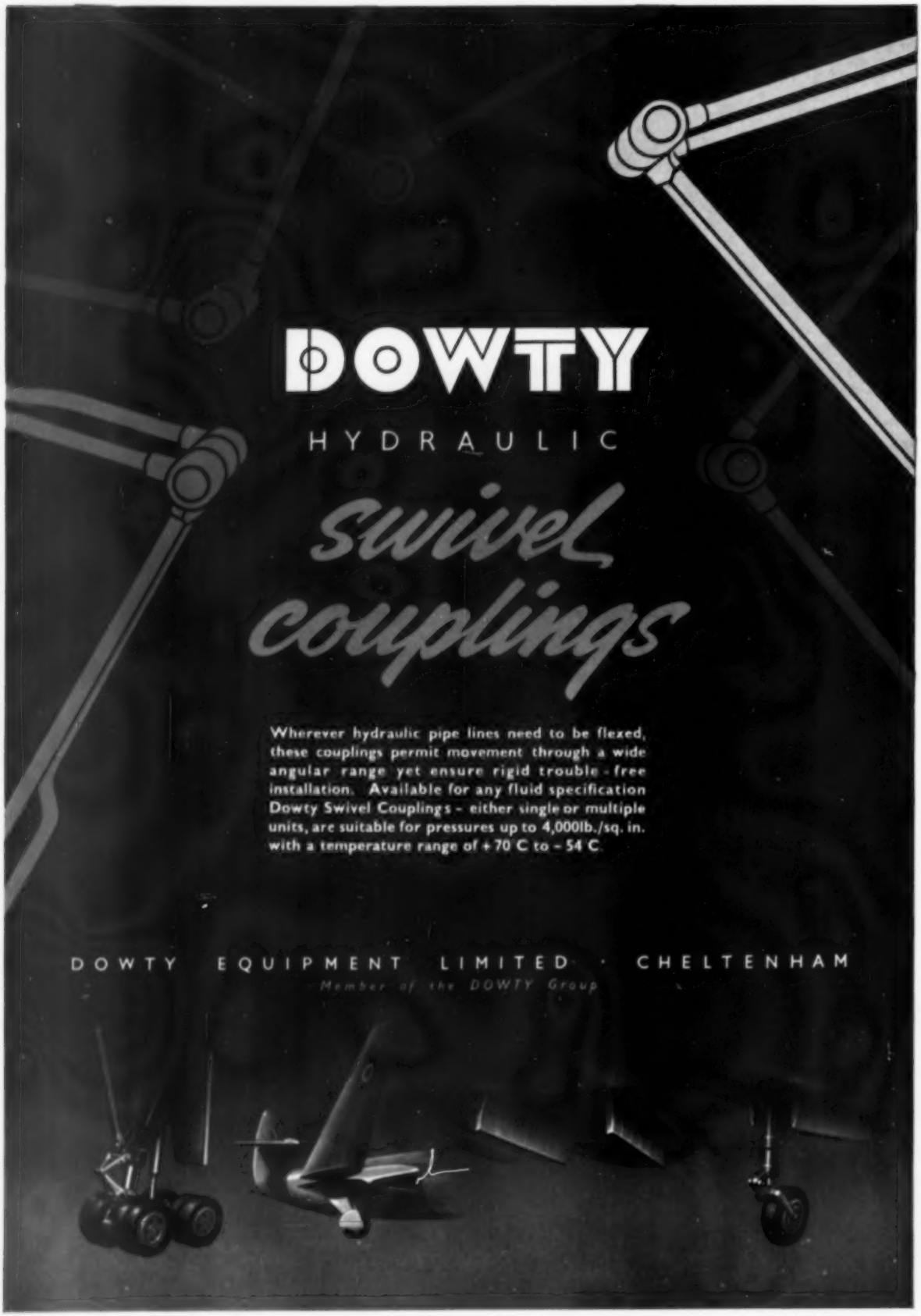
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The British Helicopter Industry

Is it Working on the Right Lines? A Critical Examination

FROM time to time we hear criticisms of current methods of helicopter development and production in this country; but few of the critics agree on what, if anything, is wrong, and fewer still seem prepared to make constructive suggestions. One of the exceptions is the author of this article, himself a member of the industry. His views may well provoke controversy that will serve to clarify the present situation.

TECHNICALLY, this country's helicopter industry is inferior to its American counterpart, and at any given time its products are comparable with those produced by the Americans between four and six years earlier. Quite a lot of dust was raised at high level when, recently, this unpalatable truth filtered through to the national consciousness.

It was notable that throughout the entire fracas not one designer or technician was recorded as saying anything, despite the fact that the practising technician is in a better position than anyone else to assess such a situation and apportion any blame. The reason seems to be that any considered statement by a technician would put him in bad odour with his directors or the Ministry of Supply, or both, and would violate the rigid code that one must not criticise the products of any other company in print.

This position is exactly analogous to that dark period in the history of the Church, when any non-laudatory comments on its working theology led to a session in the Test House, followed by the ceremony of After-burning. It is said that the Church's lack of sympathy with heretics was its fundamental weakness at that time; and to this particular heretic it seems that the lack of internal criticism in the helicopter industry by reasonably well-informed technicians has already allowed serious errors of judgment to be made, and may result in still more serious mistakes.

It is very difficult for anyone outside the Ministry of Supply to guess at the national policy which is being followed with respect to helicopters. There are five firms known to be receiving official support, and they can be divided into groups as follows: *American Licences:* Westlands. *"Contract" Companies:* Bristol and Saunders-Roe (conventional shaft-drive designs); Fairey and Hunting-Percival (gas-drive rotor systems).

One must admire the logic and business acumen of the Westland position, since if American designs are four to six years ahead of our own it follows that they can be built under licence to satisfy a ready market in this country without any of the risks which building a new design would involve. But this policy, although no doubt rewarding for the company concerned, cannot be generally applied if we are to regain the lead in the rotating-wing field. [There is, to our knowledge, no clause in the Sikorsky/Westland licence agreement which would prevent the British firm improving on a basic Sikorsky design. Different engines, for example, might enable Westlands to develop the aircraft beyond the stage reached by the design firm.—Ed.]

The remaining four companies are classed as "contract" firms, although it is not known whether Saunders-Roe are in fact working to a contract at the moment. It is immediately evident that we have our eggs in two baskets, and that a gas-drive rotor is the only alternative to the shaft-driven type. This is presumably a function of the very limited amount of money allocated to helicopters in the Air Estimates, and the argument behind it probably runs on the following lines. If we are to overtake the Americans we must "do a Comet on them." The two most promising ways of doing this are the hot and cold pressure-jet systems, and these are being developed by the Hunting-Percival and Fairey companies respectively. In case these projects fail completely it is essential to have a good orthodox design to fall back upon, and this requirement seems to have been met by giving large military orders to Bristol for shaft-driven tandems.

In the event of the pressure-jet machines proving unsuitable for civil operation it would obviously be a simple matter to put a civilian version of a Bristol tandem into production. The interim period can be covered by using the Westland-Sikorsky S-55, as in fact B.E.A. already plan to do.

On the military side only, shaft-driven designs can be regarded as suitable for active service for some time to come, so the Services must perforce be content to lag behind the Americans indefinitely. This is acceptable, since the Americans are as much our allies in Service matters as they are our rivals in civil aviation.

In this attempt to guess at official policy it is assumed that the Ministry is interested only in large helicopters, and the assumption seems reasonable in the light of past events. It is true that an order has been placed with Fairey for an ultra-light two-seat machine, but this appears to be a S.N.C.A.S.O. Djinn type of design, with the addition of moderate tip-burning to improve the performance, and it is hardly likely therefore to have any wide civil application.

There has so far been no encouragement at all to produce a two/four-seat general-purpose helicopter suitable for quantity production which could sell in the £3,000-£5,000 price range, although the design would be quite straightforward with our present knowledge. It may be that the Ministry feels that such a machine could easily be tackled as a private venture; but such a belief would be very misplaced, to say the least, because of certain fundamental defects in the structure of the industry.

The most obvious defect is simple to state: there are enough senior technicians and engineers in the helicopter industry adequately to staff one design team, but at the moment they are distributed among seven firms. This means that in the design of any project some aspects are never investigated unless trouble is experienced during flight testing. It is, for example, most unusual for any stability calculations to be made before the first flight of a helicopter, a fact which must seem incredible to fixed-wing technicians. Another illustration is provided by rotor and control vibration. It would be difficult to over-estimate the importance, to the future of the helicopter, of coming to terms with vibration; yet the average design office knows little or nothing about the subject. This ignorance has led to design features in both present-day and projected designs which, to put it politely, represent an indirect approach to the problem.

It seems that the first requirement of the industry is a great increase in the number of the experienced technicians and engineers who actually design the helicopters. This is virtually impossible to achieve when the whole aircraft industry is short of engineers, and no real hope of an improvement can be entertained so long as they are treated (and paid) like a sort of jumped-up clerk, whilst America and Canada offer a decent livelihood and professional status.

Alternative solutions must therefore be sought, and it seems that they might take two forms. One method would be to concentrate all technicians into one firm, preferably under a chief designer who understood how a helicopter flies and had a rough idea of how it works; the other would be to encourage the design of small helicopters of such a type that the need for a large design-team was avoided.

As an example of the second solution, design of a light ramjet helicopter avoids the need for transmission experts, and the absence of drag hinges or undercarriage springs removes the need for ground-resonance technicians. And since the first flights involve only hovering a few feet from the ground more stability and control problems can be tackled by flight test than is possible with a fixed-wing machine, which must be aerodynamically perfect before the first take-off.

There seems no reason to doubt that a properly designed light helicopter produced in this country could substantially under-sell American helicopters of the Bell and Hiller 360 class and be more economical to operate. Such a machine would have a very large market potential in Europe alone, and its production would mean that British design effort was being usefully exported in the form of hardware to earn credit, instead of being confined to designing helicopters suitable for the domestic market only. It would be better to try to catch up in one field, and by producing and selling a large number of small helicopters abroad we could devote part of this income to satisfying our modest requirements for American transport helicopters.

To design only one large helicopter would tax the resources of our industry, yet at least three main types and a number of sub-types are being designed. If they are a success one would expect Messrs. Piasecki and Sikorsky to retire from very shame! For example, Mr. Piasecki had thirty technicians in his ground-resonance department a year ago, whilst the number of competent dynamicists in the whole British industry does not exceed ten. It does appear, therefore, that either we are being totally unrealistic or the Americans are being extraordinarily extravagant.

Accepting that the British industry cannot essay the whole field of helicopter design, there remains the problem of selecting the most profitable fields for future work. Whatever the solution, it is important that the decision be taken soon.

It may be argued that responsible officials have already weighed up the situation, and that present contracts represent their considered opinion. This is difficult to accept. It would not be proper to publish the number of technicians employed by the M.o.S. on helicopter work, but the figure is a true reflection of the number employed in the industry. For any given contract it would be quite impossible for them thoroughly to check the claims of even one of the half-dozen or so tenders that they would receive, even if they had the necessary experience and knowledge.

Thus it is difficult to see how contracts can be awarded on technical merit; it is, indeed, often drummed into project

THE BRITISH HELICOPTER INDUSTRY . . .

engineers that the lines of the design and the presentation of the brochure are more important than the technical merit. The job of the project office is to produce a project which "looks right," after which it is up to the directors, chief designer, and politically adept administrators to sell the idea to the Ministry and damn their competitors with what faint praise they can manage to slip in.

Once the contract has been obtained the design can be re-hashed and put into a more practical form. It is interesting to note in passing that the art of selling one's firm to the Ministry affects the way of life of the whole aircraft industry, and is responsible for such widely differing phenomena as full page advertisements in *Flight* and lectures read before learned societies.

The inherent weakness in this situation is that contracts do not always go to finance technically sound projects.

Mr. John Brown's lecture to the Helicopter Association last autumn was an interesting independent testimony of the poor theoretical performance of pressure jets, and it was given with the authority of the National Gas Turbine Establishment. If Mr. Brown had had access to drawings of the mechanism necessary to duct gas through a rotor head and out along the blades it is probable that he would have come down even more strongly in favour of shaft drive.

It is always found that project weight estimates are low (there is a pair of floats in this country whose actual weight is 800 per cent of the project estimate) and since data exist only for shaft-drive installations we are very prone to conclude that hypothetical alternatives are lighter.

Before pressure-jet systems can fly, problems of control and vibration will have to be solved which, to say the least, are arduous. And in France S.N.C.A.S.O.—who lead the world in pressure-jet design, having assumed the mantle (or part of it) of Doblehoff in 1945—have come to the conclusion that tip-burning is not practical with a pressure jet. Is it not to pile our eggs dangerously high in one basket, when the requirement for an ultra-light helicopter enables another contract to be placed, again to award it to a pressure-jet design?

A third malady which impairs the efficiency of the helicopter industry is the lack of any basic research at the Royal Aircraft Establishment or elsewhere. There is not even a standard method of estimating performance reliability, and any deviation from a strictly conventional design means that the company involved has no external guidance whatsoever. If some of more recent large orders for helicopters had been 10 per cent smaller and the difference devoted to financing a five-year programme of basic research the future would have been a little more secure for all helicopter designers.

Despite its imperfections, the writer wishes to remain in the helicopter industry. After the wigging that Galileo received it is perhaps for the best if he signs this article A. HERETIC.

THE HELICOPTER AS A LIFEBOAT

IN sending us the accompanying notes, Mr. F. H. Robertson—who was recently appointed chief project designer to Short Bros. and Harland, Ltd.—remarks that our leading article of February 4th suggested two uses for the helicopter which, in his view, this type of aircraft could fulfil better than any other. In a Belfast R.Ae.S. lecture earlier this year he drew the conclusion that the helicopter's future lies in those fields in which its capabilities are unique. In his view, operating cost leaves it "without a hope" of competing with fixed-wing aircraft in other directions.

THE Royal National Lifeboat Institution operates 150 lifeboats around the shores of Britain. Due to the limited speed of the lifeboat, these could certainly be replaced by about one-third that number of suitable helicopters and, what is more important, the lifeboat can only carry out rescue operations at sea, whereas the helicopter can be equally effective over floods, marshes or mountains.

The same chain of helicopters could improve their utilization by providing service, crew transport, etc., to all the lightships, lighthouses and buoys around our coasts; a duty which is at present carried out by fairly large ships—large, because their slow speed demands a round trip to a large number of stations at a time. It could also take over coastguard duties.

The most severe criticisms which can be levelled at the present-day helicopter are, undoubtedly, the facts that it is expensive to buy and very expensive to maintain, and has too short a life. For the purpose at present being examined, the first case is not terribly important—after all, a lifeboat is very expensive compared with any other boat of similar size—but simple, inexpensive maintenance, great robustness and long life are essentials.

These qualities can be built into a flying machine—even if it is a fatigue-producer like a helicopter—by allowing the empty to gross weight ratio to rise.

Such a policy would, no doubt, horrify the purist who works out how much it costs in pence per ton-mile to rescue a drowning mariner; but, of course, in this case, payload efficiency is quite irrelevant when compared with the ability to do the job all the year round in any weather with the minimum of maintenance and the maximum of safety.

The Sikorsky S-55 is probably the best helicopter to use as an example of current modern practice; this machine has a tare to gross weight ratio of 58½ per cent and will lift a total of twelve people on 600 h.p. for a gross weight of 3½ tons.

Assuming that we could get the desired standard of robustness for a tare to gross weight ratio of 70 per cent and that we want to lift twenty-four people, our R.N.L.I. helicopter would weigh almost nine tons and would require 1,650 h.p. It would probably be sensible to over-power it and fit twin de-rated engines to give reliability and safety.

A helicopter like this could be produced for about £75,000 to £100,000 if a quantity of about 200 were built, and I cannot see that there would ever be much point in replacing it by something "more efficient." The supply of spares, provision of after-sales service and steady replacement of aircraft would provide continuous employment for a medium-sized firm for a more or less indefinite period.

Passing on to police duties, the vital needs are again robustness, reliability and simplicity of maintenance. The carrying capacity does not need to be greater than the average big car—say, four to five people and sundry tools, baggage or equipment; a total of about half-a-ton. Taking the S-55 again as a measuring stick and increasing the tare weight to 70 per cent, the a.u.w. should be a little under three tons and the power required just under 550 h.p.

It should be capable of production at a price between £25,000 and £33,000 if quantities of 200 are contemplated.

HIGH IN THE ARMY'S ESTIMATION

LIKE the estimates for the other two Services, dealt with elsewhere in this issue, the *Army Estimates*—issued* last week—were accompanied by an explanatory statement by the responsible Minister.

In this statement, the Secretary of State for War made several brief but complimentary allusions to aircraft. The work of helicopters in Malaya he characterized as "invaluable," saying that the knowledge that a wounded man could be speedily evacuated to hospital had a great effect on the morale of the security forces engaged on operations in the deep jungle. In Kenya during the past year, most effective support had been given to the ground troops by the Royal Air Force. Techniques for locating terrorist hides by means of air photography had been improved and methods had been developed whereby accurate bombing could be carried out in all weather conditions.

The value of air trooping was appreciated in these words:—

"Air trooping has been steadily increasing its share of the total load during the past few years and has now reached some 49 per cent of the total Army trooping to and from theatres other than the British Army of the Rhine. In October last year a new contract for the operation of an air trooping service to Singapore was placed, and the service is now carrying about 1,000 passengers a month in each direction. Hermes aircraft are used for this service and also to East Africa and Cyprus. We want to encourage the use of more modern aircraft on other routes and some Viscounts will, we hope, shortly be introduced. In addition we plan to bring Britannias into service when they are available, in about three years time.

"Air trooping by reducing the time spent by troops *en route* gives a manpower saving of about one-seventh on the Far East route, so that out of 10,000 men moved in a year we are gaining 1,400 or 1,500 in effective manpower in the field. To a smaller extent the same applies to the Middle East, Mediterranean, East and West Africa, to each of which all trooping, except unit moves, is done by air. Furthermore, air passages to the Far East and Middle East are costing us less per head than sea passages."

In a review of "The Army and the Future," the Minister observes that, though helicopter experiments are starting, progress will be slow, as quantity production of a heavy load vertical-lift aircraft, helicopter or otherwise, is still some way off.

*Cmd. 9395, *Her Majesty's Stationery Office; price 9d.*

NAVAL AIR POWER

Carriers and Aircraft Discussed in Navy Estimates Statement

INTRODUCING his *Explanatory Statement on the Navy Estimates 1955-56*, published* last week, Mr. J. P. L. Thomas, First Lord of the Admiralty, began by outlining the Royal Navy's place in the thermo-nuclear weapon age. Battle groups of aircraft carriers, guided-missile ships and their escorts were seen as part of the British contribution to allied navies of the future. They would replace in effect the concentrated main fleets of past wars and provide the strength on which all other naval activities depended. By their ability to disperse and reconcentrate at will they would remain, in the thermo-nuclear era, both an elusive and a hard-hitting fighting force.

The Royal Navy required, therefore, carriers operating the latest aircraft; powerful ships armed with guided weapons; escorts capable, in co-operation with carrier and shore-based air forces, of providing protection for our shipping; submarines and amphibious forces; and minesweepers to keep the sea lanes clear for vital supplies. All of these ships must be well equipped and efficient and maintained in a high state of readiness.

The fleet carrier, continued Mr. Thomas, was the most powerful vessel in Naval service: she was armed with squadrons of aircraft which could defend our ships against surface, air and submarine attack, destroy enemy submarines and aircraft at sea or at their bases, attack shore targets and in certain areas support Army operations ashore. The modern carrier embodied the three British inventions, the angled deck, the steam catapult, and the mirror landing device, now being adopted by the navies of other NATO countries. So equipped, a carrier could operate the latest types of aircraft, including those capable of delivering the atomic bomb.

**Cmd. 9396, Her Majesty's Stationery Office; price 9d.*

In the coming year, the operational Fleet would include the heavy carriers *Ark Royal* and *Eagle* and the light Fleet Carriers *Albion* and *Centaur*, while *Bulwark* would be engaged on aircraft trials and training. "These ships," said the First Lord, "will make up the fists of the Fleet and provide it with a formidable punch."

Some brief but titillating allusions to forthcoming aircraft were made by Mr. Thomas in the part of his statement relating to the Fleet Air Arm; in this, after further allusions to carriers, he said:—

"At the present time, the Sea Hawk and Sea Venom provide the day and all-weather fighter strength of the Fleet Air Arm, but, as has already been announced, orders have been placed for new aircraft which will in due course supersede them. These replacements are the N.113 and D.H.110 respectively. They will have a greatly improved performance and will be equipped to carry guided missiles as well as guns. [The N.113 is the forthcoming development of the Vickers-Armstrongs Supermarine 525. —ED.]

"In the sphere of anti-submarine warfare, the turboprop Gannet has come into service and squadrons have already been formed. This aircraft and its equipment show great promise. Furthermore, intensive trials and experiments with the use of helicopters for anti-submarine work have proved their value in this role, and a helicopter specially designed for anti-submarine work has been ordered.

"For strike operations, a replacement is planned for the Wyvern. This aircraft will add greatly to the strike potential of the Royal Navy; it will be capable of carrying an atomic bomb, and will have a far greater range and speed than any previous Naval strike aircraft. [This will, presumably, be a pure-jet aircraft, as distinct from a turboprop.—Ed.]

AMERICA AND JET NOISE

REPORTS from the United States show that, even more seriously than in Britain, the problem of jet noise is occupying the attention of the aircraft- and engine-manufacturers and the Services. The volume and power of complaint which the American public is able to direct at those responsible has compelled the preparation of firm plans of action.

The main cause of complaint is ground-running of engines. Though this cannot be eliminated, the nuisance can be reduced by the use of noise-suppression devices which, though expensive, are easy enough to instal. Mufflers of various types have therefore been erected by almost all the major jet aircraft and turbojet manufacturers. But noise persists—for instance, during take-off and landing and necessary low-flying—and for this problem the best solution, short of removal to less populated areas, has been found to be efficient and energetic public relations work.

A particular example of dealing with noise is provided by the Martin Company at Middle River, Maryland. After complaints had been received of the noise of ground-running the J-65 Sapphires of their B-57 Canberras in the middle of the night, orders were issued that all ground-running must be done with the company's sound-mufflers in position. These mufflers could accommodate two B-57s at a time; and if more than two had to be run up, hangars were to be used as sound baffles. Landing and take-off procedures were then adjusted so that aircraft kept as far as possible away from neighbouring built-up areas, and curfews were set on both flying and ground-running—for instance, for a period around 2 p.m. when babies were enjoying their postprandial naps. Finally, the company's staff were instructed in dealing with telephoned complaints. They were told to agree that jets were noisy, but to point out that the noise was necessary in the interests of the nation's security.

Similar methods are now being employed by most of the major American aircraft and engine firms, particularly in the Los Angeles region; and it is noteworthy that good public relations work appears to rank equally with efficient sound-muffling in reducing complaints from the public. Republic Aircraft have contacted organizations and officials of many kinds within a 15-mile radius of their Farmingdale, Long Island, plant to explain the purpose of their flight- and ground-test operations. Complaints are met with detailed explanations of the reason for the particular noise (aircraft deliveries, special tests, etc.) and it is claimed that 99 per cent of the complainants are grateful for thus being taken into the company's confidence.

One of the particular trouble-spots is Los Angeles International Airport, used for engine and flight-testing by North American and Douglas (El Segundo) among others. Both companies have installed special mufflers and fixed curfews for engine-running. A number of companies, however, have gone so far as to move their flight-testing sections to the new $30 million U.S.A.F. production and test centre at Palmdale. Lockheed, by so doing, escaped a major lawsuit brewing over noise at their normal base at Van Nuys. Northrop, Convair and North American have also moved some sections to Palmdale, while Douglas has set up production flight testing of the B-66 and RB-66 at Tucson Municipal Airport, Arizona. All these adjustments are being carried out at considerable expense to the companies concerned.

Operational units of the U.S.A.F. itself are not without their noise problems. Here, more than ever, public relations work has produced excellent results, and there is at least one case on record where careful efforts over a period of months have completely altered the attitude of a local township to a nearby jet-aircraft base. At Moses Lake, Washington, in another instance, residents expressed concern about the noise of forthcoming operational trials of the Boeing B-52 at nearby Larson Air Force Base. To show what might be expected, the Air Force Base arranged for a formation of several jet aircraft, equivalent in total noise value to the B-52, to fly over the town so that residents could actually gauge their reactions and avoid premature exaggeration and worry.

While attempts are being made in such ways to alleviate the effects of turbojet noise, Air Research Development Command is continuing work on the source of noise—the jet engine itself; but they hold out little hope of any worthwhile remedies, yet awhile, which do not at the same time reduce engine performance by an unacceptable margin.

IN OTHER SPHERES

A REMINDER that brighter days will soon be with us is the appearance of spring numbers of two of *Flight's* associated journals. *The Autocar* Spring and Touring Number comes out next Friday, March 11th; and on Wednesday next, the 9th, *Amateur Photographer* publishes its annual Outdoor Number, which this year contains a supplement giving illustrated reviews of exposure meters, range-finders and colour filters on the British market.

In a more strictly industrial field, this time concerning firms who operate their own transport fleets, is *Motor Transport's* "C" Licence Number, on March 11th. This will show how fleets should be organized for maximum efficiency, and how the latest methods of costing and maintenance can help to reduce costs and speed the movement of goods and materials.

S.14s BEGIN to FLOW

PRODUCTION of the Fokker S.14 advanced jet trainer is now in hand at the makers' new factory at Schiphol Airport, Amsterdam. The first production machine flew on January 15th, and it has subsequently completed three hours and 19 minutes in the air. Capt. Sonderman, the chief test pilot, felt sufficient confidence in the aircraft to take it through the full gamut of aerobatics at comparatively low level on its second flight.

The Nene-powered S.14 prototype has now completed 141 hours of flying. This time includes evaluation flights by several foreign missions and by NATO evaluation teams. The aircraft is understood to have earned high praise from all these independent assessors, and it would not be surprising if later it became the subject of a NATO standard trainer order. The aircraft now coming off the production lines are powered by Derwent 8s.

Although the design has flown with a Rolls-Royce Nene, production S.14s utilize F.N.-built Derwent 8s. The first production machine, illustrated here, looks smart in its British-training uniform; left, below, are the Dowty/Dunlop nose and main undercarriage units.

The present contracts total 20 aircraft for the Royal Netherlands Air Force and five more for manufacture in Holland but assembly in Brazil. An additional 45 will be manufactured in South America, to follow on after the assembly of the five.

Production S.14s differ from the prototype only in detail. A new Dowty landing gear is fitted, an all-plastic cockpit canopy is employed, aerials and one pitot head are differently mounted and more inspection doors are provided in the fuselage. There have been minor improvements in the cockpit layout. The colour scheme is silver, with training-yellow bands.

At Amsterdam the first detachable gun-pack for the S.14 is almost completed and firing trials are to be made in the next month or two.

The dimensions of the S.14 remain the same with either Derwent 8 (3,470 lb thrust) or Nene 3 (5,100 lb thrust) turbojet. Some representative performance figures for the production Derwent version, with the equivalent Nene-powered figure given in parenthesis, are:—Maximum speed, 455 m.p.h. (536 m.p.h.); mean cruising speed at 30,000ft, 355 m.p.h. (484 m.p.h.); sea-level rate of climb, 3,100 ft/min (5,450 ft/min); time to 30,000ft, 19.4 min (11.8 min); minimum speed (flaps 45 deg), 88 m.p.h. (90 m.p.h.); take-off gross weight, 11,800 lb (12,230 lb).

REMEMBERING THE EASTCHURCH PIONEERS

THE earliest days of flying with heavier-than-air machines in Great Britain are recalled by the preparations now being made to erect a memorial to the pioneers who worked at the first home of British aviation, at Eastchurch, Isle of Sheppey.

The memorial will be near the site, too, of the first aircraft factory in Britain, established by the Short brothers, and of the first Royal Naval air station. Names that will appear on it will be those of Moore-Brabazon (now Lord Brabazon of Tara), the Hon. C. S. Rolls, Frank McClean, Tom Sopwith (now Sir Thomas Sopwith, head of the Hawker-Siddeley Group), Alec Ogilvie, and others who have immortalized British Aviation—men such as the three Short brothers, and Lt-Cdr. Samson, and Lt. Longmore, all of them inseparable links with the foundation of heavier-than-air flying in this country.

The idea of the memorial was put forward five years ago, and was sponsored by Short Brothers, Sir Winston Churchill and Lord Brabazon. There was ready approval to the proposal, and for the design, and the memorial is now being prepared with a view to an unveiling in the early summer.

It takes the form of a carved wall, to be built on a corner site opposite the church at Eastchurch, and on the road leading to the site of the first R.N. air station. It is to be constructed of Kent ragstone to harmonize with the church structure and will be topped by Portland stone panels bearing carved representations of early aircraft, of such makes as Handley Page, Short, Bristol and Howard Wright.

An inscription on the main panel will record, in sunken Roman letters, a commemoration of the site. Another tablet will bear the names of 12 pioneers of aviation; and on a third will be inscribed the names of Eustace, Oswald and Horace Short, who, at Eastchurch, pioneered aircraft construction in this country. On a fourth panel will be the names of the first four Naval officers to learn to fly here, Lts. C. R. Samson, R. Gregory, A. Longmore (now Air Chief Marshal Sir Arthur Longmore), and Capt. E. Gerrard, R.M.L.I. Surmounting the centre of the wall will be the commanding stone figure of Zeus, Greek god of the heavens, holding a bar of "lightning" and surrounded by cloud forms. Zeus, and other stone carvings to be incorporated in the memorial, are now taking shape in the studio near Horsham, Sussex, of Hilary Stratton, the designer.

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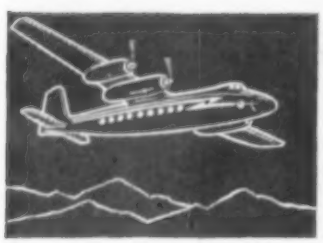

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HANDLEY PAGE

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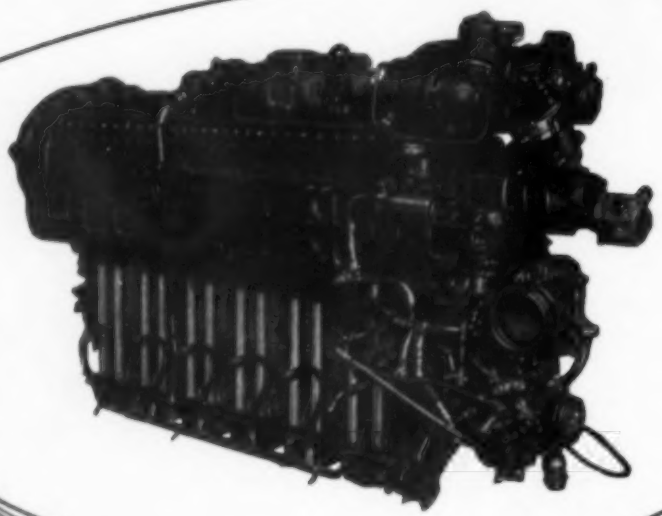

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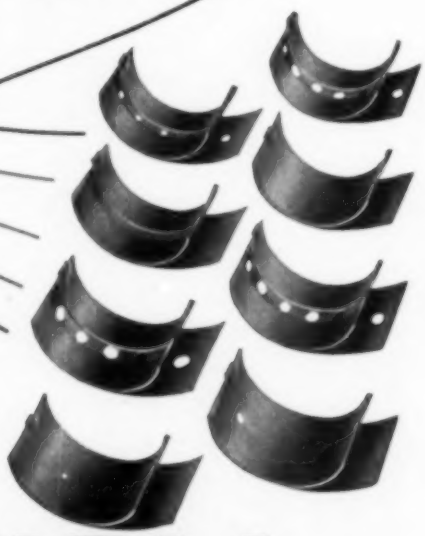

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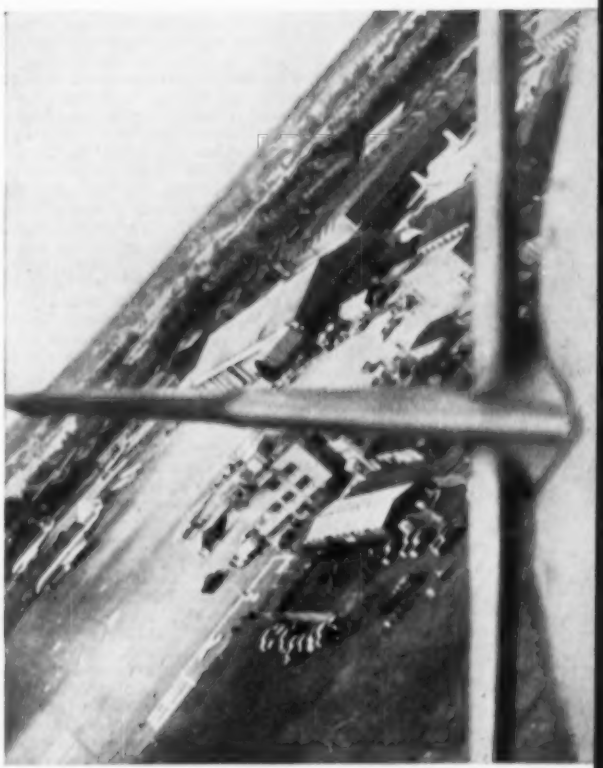
A.O.P.9 DELIVERY BEGINS

Versatile Austers for the Army

ON June 11th last year we published a full description of the Auster A.O.P.9 (Blackburn Cirrus Bombardier), the multi-purpose machine developed by Auster Aircraft, of Leicester, to meet the requirements of the British Army. The prototype flew for the first time on March 19th, 1954, and has since completed a very extensive period of flying trials and service evaluation. These trials were described in our issue for December 10th.

Now, only 11 months from the date of the first flight, production deliveries are being made. The heading photograph was taken on February 11th, and shows the first three machines to be delivered—WZ666 to 668—being run-up at the makers' airfield at Rearsby before being ferried by company pilots to No. 19 Maintenance Unit, at St. Athan, South Wales. On the following day, a further batch of three A.O.P.9s were flown to the same M.U.



Below, WZ664 (the first machine was 662) is about to land in a rough stubble field during proving trials. The neat undercarriage is a Dowty Liquid Spring unit. On the right is a lively impression of Farnborough's north side, taken over the tail of an A.O.P.9.

"Flight" photograph

ITALIAN LIGHT FIGHTER

A PROTOTYPE of the Sagittario light fighter is at present being built for the Italian Air Force in the Aerfer Factory at Pomigliano d'Arco near Naples. The aircraft is in many respects a direct development of its predecessor, the Marboré-powered Sagittario I, but it will be capable of exceeding Mach 1 in a dive, with the power of a Rolls-Royce Derwent. Performance information is still restricted by the Italian Air Force, but some structural details have been released.

The engine is mounted ahead of the main fuselage structure in a nose cone, with the jet-pipe discharging under the after fuselage. The fuselage itself is an independent structure, capable of accommodating a large quantity of fuel. Built in one piece with very thick skins, the wing is attached to the lower fuselage section above the jet-pipe. The tailplane is a one piece, all-moving assembly.

Among possibilities for development are the installation of a second engine in the after fuselage, the object being to achieve power boost and twin-engine reliability with two engines not necessarily of the same type or power.

The Aerfer company at present produces parts under American aircraft contract and claims to have considerable facilities for eventual Sagittario production. From another source, meanwhile, it appears that the U.S.A.F. may be changing its opinions about the need for a light fighter, and that such aircraft may now not be ordered at all.

RUSSIAN AIRCRAFT IN BRAZIL

NOTWITHSTANDING American rumours alleging highly secret reasons for the appearance on Brazilian airfields of a Soviet transport aircraft, the facts are, according to Brazil radio, that "a Russian transport plane landed at the airport of Espiritu Santo. The plane bore a Red Star emblem and a Hammer and Sickle, as well as the inscription *Soviet Union, Alexander Suborov.*" The Russian machine was said to have been guided in by aircraft of Argentine Airlines, and to have been intended to collect a cargo of "special steel alloy" for Czechoslovakia—a nation with which Brazil maintains diplomatic and trade relations.

Implications of Rocket Propulsion

Mr. A. V. Cleaver's Lecture Before the R.U.S.I.

RECOGNIZED as one of the world's leading rocket engineers, Mr. A. V. Cleaver, F.R.Ae.S., delivered a notable lecture on February 23rd before the Royal United Service Institution. The title—"Rocket Propulsion and its Implications to Human Society"—was suggested by the R.U.S.I. itself, and the lecturer's treatment covered the technique of propulsion, the past, the present, the future, and implications of the system—the latter considered under the sub-headings "physical" and "psychological." Mr. Cleaver, incidentally, spoke in a purely personal—or, perhaps, British Interplanetary Society—capacity, his views not being in any way associated with his post of chief engineer of the rocket division of the de Havilland Engine Co., Ltd.

The next few decades, said Mr. Cleaver, would undoubtedly bring forth many more spectacular examples of supersonic rocket aircraft and guided missiles. In the latter field, especially, progress would be very marked, leading eventually to the production of very-long-range intercontinental missiles. Of course, not all missiles would necessarily be rocket-propelled (for some classes, ramjet or even turbojet engines had considerable claims); however, the trend towards rocket propulsion was inevitable as higher speeds and altitudes (or, indirectly, longer range) were demanded.

The implication of all these developments to the Services would seem to be fairly obvious in broad outline, although far from obvious in detail. In the first place, it seemed that they must result in a continued and increasing trend towards the need for more specialists with highly technical qualifications, as ground staff for both operational and maintenance duties. Correspondingly, the demand for large numbers of non-specialist personnel should decrease, if the conventional armies, navies and air forces began gradually to be relegated in the main to roles of providing occupation forces and transport facilities. The Navy, however, might very well find itself called upon to fulfil an important new function of providing specialist ships, perhaps large nuclear-powered submarines, as mobile bases, which it would be difficult for an enemy to locate and destroy, for launching retaliatory guided missiles. There might also be some use of piloted rocket aircraft of extremely high performance for bombing or missile-launching duties, or even for reconnaissance, if such futuristic schemes as those of Sänger in wartime Germany, or (more recently) of Dornberger at Bell in the United States, finally proved worthy of attention.

As to how long such changes might take to come about, all that could be said with any certainty was that it would be a very much longer and more gradual process than was usually suggested by the prophets of push-button warfare in the more sensational newspapers, but perhaps not quite so long as the most conservative armchair sceptics might believe. The lecturer then referred his audience to Field Marshal Montgomery's lecture last October to the R.U.S.I., and thought they would agree that this was the general impression he gave when he was discussing such developments as the long-range ballistic rocket. It was not here yet, it still would not be for some years to come, but one day it was likely to supersede the strategic bomber as the dominant factor in at least the early stages of any major war. Its very existence as such a factor, together with the truly horrifying capabilities of the nuclear warheads which it would deliver with so little risk of any interference, might constitute our best hope that such a war would never occur at all. The potential aggressor would have a perfect weapon for instant attack, without any appreciable warning, but stalemate would result from his certainty of an immediate and equally devastating retaliation. Mr. Cleaver added that we must fervently hope that this would prove to be so. Otherwise, he was afraid that most of the further possibilities discussed in his paper might be of no more than academic interest to our civilization.

Because the long-range rocket was certain to be produced in the relatively near future, he went on, we might also be fairly sure of at least one further development. Probably within the next decade some adaptation of such unmanned vehicles, to form a multi-stage rocket assembly, would be used to provide the Earth with a small and probably temporary artificial satellite. The small upper component of this assembly would be given a sufficient circular velocity beyond the atmosphere to enable it to circle the Earth as an artificial moon, the gravitational pull on it being balanced by centrifugal force, as for the real Moon—or (for that matter) as for the Earth in its circular orbit around the Sun. If placed at a height of more than a few hundred miles, such a satellite rocket would remain in position indefinitely without further propulsion; otherwise, the residual air resistance would bring it down within a few days or weeks, to be destroyed by aerodynamic heating before it reached the ground. It would carry automatic instruments which would radio their readings of scientific data back to base, and it would form a most logical and invaluable extension to the large programme of high-altitude rocket research which the Americans had already undertaken. This was a project which had received a very great deal of serious scientific attention in the United States and elsewhere during the last few years. What *could* happen, as a further development from this first modest achievement of rocket flight beyond the atmosphere, might bear much the same relation to it as did the whole field of modern military and civil aviation to the first model aeroplane of Henson and Stringfellow in the mid-19th century.

Discussing physical implications, Mr. Cleaver said that rocket flight beyond the atmosphere would add greatly to our scientific knowledge. The high-altitude rocket had already made considerable contributions to our knowledge of conditions in the upper atmosphere as regards such matters as radio-wave propagation, meteorology, solar phenomena and cosmic radiation. The last subject alone was of immense significance to our understanding of nuclear physics, for the primary cosmic rays (which did not penetrate through the atmosphere to sea level) consisted of particles of higher energy than any which could yet (or perhaps ever would) be produced in a laboratory. When rocket vehicles, first unmanned and then later with human crews, could achieve extended satellite flight in space, their usefulness for gathering such data would be greatly enhanced. Astronomers, too, would welcome the eventual possibility of placing their telescopes and other instruments beyond the blanket of the Earth's atmosphere, which seriously hampered almost all observations, even from regions of cloudless skies. Astronomy was, of course, no purely academic study; it had been the nursery of many practically useful discoveries and inventions, from navigation to the thermo-nuclear reactions.

It was very likely that the end of this century would see permanent satellite observatories, of various types, circling in different orbits beyond the atmosphere. They might be space stations of the kind envisaged by von Braun and others, or (perhaps more probably) they might be large rocket vehicles relieving one another periodically, as the weather ships did now, out in the North Atlantic. Some would be concerned with astronomical observation; some with weather forecasting, having the whole of the world's weather in view; some might be employed as navigational aids for surface transport, or for surveying the Earth's surface; others again, for various types of scientific research which we could not yet envisage. It was interesting to speculate on what new knowledge in physics might emerge from experiments in the gravity-free and airless conditions of outer space.

One particularly interesting practical possibility concerned the use of satellite rockets as radio-relay stations for the short wavelengths which otherwise were restricted in range by the Earth's curvature.

Further away in the future, but not by any means inconceivable, was the possibility of Earth's one day receiving other material benefits from the rest of the Solar System. Our descendants of a few centuries hence might be very interested in imports from the Moon and Mars. However, we could no more usefully speculate on these things in any detail than could the 15th-century mariners on the products of the New World. Like them, we had to get there first. We should not achieve this for some time, and when we did, in the first place it would be in ships of a payload limited to bringing back only a few specimens.

Discussing psychological implications, the lecturer said that the achievement of space flight could hardly fail to be an immensely broadening experience for the whole of human society. In these days of film and television, its impact would not be felt only by the select band of pioneers who first savoured its adventure. On the contrary, it would, in a very real sense, be shared by the whole of human society. One could easily imagine the world gazing in awe and wonderment at its television screens, when the first satellite rockets were circling out in space. When these showed the Earth as a globe in space, one world among so many, with half the Universe above and half below the tiny man-made vehicle from which all the stars of the heavens were

observed, could it be doubted that we should all be influenced in our ways of thinking?

The contemplation of a clear night sky was often recommended, and rightly so, as an antidote to any excessive pre-occupation with personal problems or other mundane affairs. How much more effective still would be the change in perspective obtainable by viewing the whole Earth, our native planet ever since the birth of our species, from outside! Perhaps we should come to realize that some of our petty concerns are not so important after all: perhaps, in some future society, the exploration of space might come in time to be accorded a higher priority than many of the "practical" affairs of 20th-century man. At all events, it would provide a preferable alternative to recurrent global wars for absorbing all the aggressive energies of mankind.

There had long been agreement among journalists that the discovery of life on some other world would be one of the biggest stories which could ever break in Fleet Street, if not the biggest of all. For that matter, the negative discovery that we were alone in the Universe would be of equal, perhaps even of greater, philosophical interest. It was quite possible that intelligent life did not exist elsewhere in our own Solar System; most reliable authorities would say that there was even a high probability that it did not. However, there was also increasing agreement among them that somewhere in the Universe a great many other planets must exist, and it would surely be a most anthropocentric view to believe it likely that Earth alone harboured what we were pleased to call an intelligent species. There remained, of course, the fascinating possibility that life elsewhere might take some form which was quite alien to our present experience or understanding; the lecturer did not necessarily mean alien in any hostile sense, but merely quite different in its essential processes. It was amusing to speculate that a race of underwater beings might decide, quite conclusively, that life would be impossible on dry land, in a gaseous atmosphere of nitrogen and oxygen.

Our first meeting with an extra-terrestrial species might occur in the not too distant future, or it might be further ahead in time than the Pharaohs lay in the past. It might be never, but if it ever *did* come to pass, then it would surely contain the most exciting implications for humanity which could possibly be imagined. If one regarded these as inevitably dangerous, Mr. Cleaver believed one was subconsciously judging all potential life on the bad past record of our own species—an interesting and provocative thought in itself. It was at least possible that the human race would gain immeasurably from such a contact with the science, art and philosophy of another world, which had developed quite independently and which might well be more advanced in its culture.

Argument by analogy could never be conclusive, and in any case, history never exactly repeated itself. However, it was hard to avoid drawing the comparison between our potential ability, within the next few decades, to make a beginning on the conquest of space, and the adventurers of the first Elizabethan Age who first crossed the wide oceans. Even the natives of Polynesia made their outrigger canoes and crossed the vast Pacific, from one little island to another. So also, sooner or later, man must build his ships to explore the immensity of space and the many strange worlds which it contained.

Concluding, Mr. Cleaver said it was hardly an exaggeration to claim that, in their full potential, these implications might be as far-reaching as those of any other idea or development which could be found in the whole present field of human activity. Because of their content of physical adventure and excitement, they were made use of by authors of works of fiction, sometimes of only a juvenile, sensational, or mediocre quality. However, they were also deserving of study by philosophers, social scientists, and other more serious imaginative workers, and indeed by us all. Our times had produced too many examples of great innovations for which the world had been quite unprepared by adequate prior consideration of their implications; usually, we had been sceptical of their importance, and had discovered otherwise to our cost.

STORIES of the SNARLER

IN a talk to the British Interplanetary Society on February 5th, Mr. Dennis Hurden of Armstrong Siddeley Motors, Ltd., spoke of some of the problems encountered in the development of the Snarler rocket motor. Although a number of these facts have already been published in Flight—in a review (August 6th, 1954) of Snarler development—we repeat them here for the benefit of readers who may not have seen the earlier article.

Mr. Hurden said that although the development of a motor similar to the Snarler would now be looked upon as a straightforward development job, at the time of its conception in 1946 it was a most unusual project. The original specification was for a 2,000-lb-thrust unit with a duration of three minutes, using liquid oxygen and aviation kerosine as propellants. The propellants were to be fed from pumps driven by the aircraft main turbojet (a Nene), two thrust levels were to be available to the pilot, and the motor should be capable of restarting in flight.

The approximate development programme was: August 1946, design work began; December 1946, first pieces of "ironmongery"—injectors—available; February 1947, first pumps available; September 1947, first combustion-chamber available; November 1947, first firing of combustion chamber; March 1949, pumps successfully developed; September 1949, automatic controls working correctly; May 1950, flight clearance obtained; November 1950, first flight.

Although it was expected that the combustion chamber would be the most difficult item to develop it was in fact one of the easiest. A regeneratively cooled chamber was used, with an inner liner machined from a forging and the outer made from two light-alloy castings joined longitudinally. Between the two was a helical coil to produce a high-velocity coolant flow. Since these chambers were difficult to produce, a start was made with water tests on various injectors, to determine the atomization, mixing and distribution characteristics. Burning tests were eventually initiated with a "mock" combustion chamber—an uncooled steel can with a plain hole at the end to simulate the expansion nozzle.

As a result of discussions with R.A.E. it was decided that the cooling problems with kerosine would be very difficult, and a 65/35 mixture of methyl alcohol and water was recommended instead. After a number of ignition tests had been carried out with the mock chamber—only two were conducted with kerosine—the first cooled chamber was delivered. The first six firings were achieved with no trouble, using water as coolant, and then the fuel was used as coolant, again successfully. On two occasions liquid oxygen was tried as a coolant, and each test resulted in an explosion.

The kerosine pump raised no difficulties, but the liquid-oxygen pump gave more trouble than the rest of the components put together. Bearings were the main source of failure. Water-cooled plain bearings were used initially, but they overheated. A bearing test-rig was then assembled and various bearings tested. Amongst the many failures was a plain bearing of asbestos impregnated with a plastic, which exploded and blew the rig to pieces. Finally they developed their own ball bearing which ran quite satisfactorily at 14,000 r.p.m. with no lubrication for about eight hours and was used in the final flight unit. Other occurrences during the liquid-oxygen-pump development were a bearing fire caused by an overheated metal face seal and an explosion of the pump assembly due to rubbing of the light-alloy rotor.

Since the liquid oxygen was at its boiling point, it was necessary to bleed off all the gas from the top of the pump in order to prime. When the motor was fitted to the Hawker P.1072 it was found to be very difficult to prime the pump, as the pipe-runs were rather longer than those on the test-bed assembly. The system had to be further developed on the test-bed to eliminate this trouble and this held up the first flight by about six weeks.

In all, six rocket-powered flights were made before the aircraft was grounded—for reasons unconnected with the rocket motor. On only one flight did trouble occur and this was not directly due to the motor. Transmitting pressure-gauges were used to indicate the pressure at various points on the system and the fluid used to fill the capillary tubes should have been inert. In error, an inflammable fluid was used and on this one flight the diaphragm of the capsule indicating the liquid oxygen injector pressure fractured, thus allowing the oxygen and filling fluid to mix. An explosion occurred in the capsule and started a small local fire, which fortunately went out before causing more than superficial damage. For the amount of development effort involved the total flying time had been disappointingly low, but the experience gained was very considerable and was proving of great use in the firm's current projects.

PRODUCTION-CONTROL STANDARDS

AMONG recent publications by the British Standards Institution is No. B.S. 2564:1955, *Control Chart Technique*. Written by Dr. B. P. Dudding and Mr. W. J. Jennett, it was originally compiled by G.E.C., and the director of their research laboratories has given permission for it to be issued as a British Standard. There are two parts, the first concerning utilization of quantitative data, and being of primary interest to industries producing large quantities of articles within dimensional limits of accuracy; the second part covers classification of products by qualitative data and is of use wherever sampling technique can be applied to the regulation of production. Copies may be obtained, price 10s 6d, from the B.S.I. Sales Branch, 2 Park Street, London, W.1.

On the left is the first photograph of a de Havilland Sea Venom FAW.53 for the Royal Australian Navy. These fine aircraft were developed by, and are in production at, the Christchurch, Hants, factory. The two Venom N.F.2s belong to No. 23 Squadron, R.A.F.

AIRCRAFT INTELLIGENCE

Great Britain

D.H. Venoms. It was announced recently (page 224 last week) that production of the de Havilland Venom F.B.1 and N.F.2 is almost complete. The principal types at present being made are the N.F.3 night fighter for the R.A.F., the F.B.4 fighter/bomber for the R.A.F. (illustrated last week) and the F.A.W.20 and 21 for the Royal Navy. Illustrated above are N.F.2s of a famous R.A.F. squadron and a Sea Venom F.A.W.53 for the Royal Australian Navy. The latter is a variant of the Mk 21, specially equipped with equipment and radar for service with Australian carriers and shore bases; it is a two-seater fitted with powered controls and many other advances introduced in the F.A.W.21. The Mk 53 will be the first all-weather fighter to serve a Commonwealth navy.

Hawker Hunter. Superficially, the Hunter F.1 (Avon) and F.2 (Sapphire) are almost identical, if such things as serial numbers are discounted. There is, however, one clear distinction. Above the port side of the engine bay of both marks is a small flush intake; on the F.2, an oil-vent outlet is to be seen just forward of, and below, this point, and, owing to the total-loss oil system of the Sapphire, a permanent oil slick can be seen stretching away behind this vent on any F.2 that has done more than an hour or so of flying. The synthetic turbine oil has a disastrous effect on squadron markings, and Dockers (at least) have supplied special resistant paint. On the F.1 the rear fuselage is perfectly clean, and the oil discharge vent is absent; there is, however, another flush vent rather further aft.

U.S.A.

Bell XV-3. It is now learned that the power unit of this tilting-rotor convertiplane is a Pratt and Whitney R-985 Wasp Junior. This is a seven-cylinder radial of about 450 rated h.p. The XV-3 was described in our issue of February 18th.

Lockheed F-104. This missile-shaped day fighter is probably the fastest military machine (as distinct from development prototypes) currently flying. It is expected that its operational speeds will be of the order of 300/400 m.p.h. faster than those of present fighters. Two aircraft, the XF-104 and YF-104, have now completed some hundreds of hours testing at Edwards A.F.B., in the course of which they have been flown by many senior U.S.A.F. officers. The present F-104 is powered by an afterburning Wright J65 Sapphire and has a very thin unswept wing with anhedral and with a span of about 28ft. There is increasing talk of later development of the F-104 series, including a machine powered by the 15,000 lb-thrust General Electric J79 and a Canadian version to succeed the F-86 in the Canadair factory.

U.S.S.R.

New bombers. Further notes on the two advanced types of bombers seen on May Day last year can be given. The larger, the four-jet Bison prototype, is like a "stretched" Valiant in layout, with the addition of a manned tail turret. The four large turbojets are completely buried in the inner wing, their tailpipes being mounted a few degrees from the longitudinal axis to ease jet-energy impingement on the rear fuselage. No information is yet available upon the undercarriage, which may be a bicycle with outriggers in the small, drooping fairings at the wing-tips. The pressurized crew compartment has a normal flight deck and also has a large transparent area for visual bombing in the extreme nose. The rakish, Valiant-size, twin-jet Badger has a similar fuselage layout, again with a manned tail turret. A conventional nosewheel undercarriage is fitted, the main units being contained within fairings mounted beneath the trailing edges of the wings. These fairings, which have twin doors, break the run of the large flaps.

NORTH AMERICAN FJ-4 FURY
(Wright J65-W-4 Sapphire)

Span 39ft 1in
Length 37ft 6in

Air Power at Sea

H.M.S. ILLUSTRIOUS

The first ship to bear the name *Illustrious* was a 74-gun third-rate. Many of the famous 74's were originally three-deck ships but had the top deck removed and hence were known by the French term "Razees". They served the Navy in the eighteenth century. The fleet carrier *Illustrious* of 23,000 tons, her modern successor, is the fourth ship of that name. Armed with her striking force of naval aircraft, she upheld the highest traditions of the Royal Navy in battle after battle between 1939 and 1945. Operating from the oceans of the world, shipborne Fairey aircraft in *Illustrious* brought many combat successes to her long list of "Battle Honours".

In this great tradition Fairey Gannet anti-submarine aircraft are equipping front-line squadrons of the Fleet Air Arm.

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FAIREY

Powered by an Armstrong Siddeley "Double Mamba"

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THE FAIREY AVIATION COMPANY LIMITED · HAYES · MIDDLESEX

UNDER INTENSIVE
DEVELOPMENT FOR
SUPERSONIC AIRCRAFT

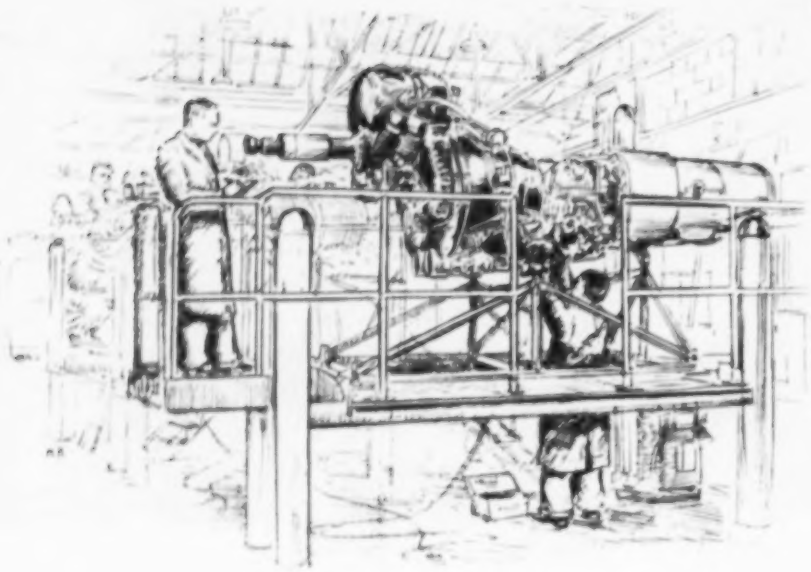
GYRON

Waikiki and L.A.P.: a study in contrariety

BOTH the fine studies reproduced on this page show transport aircraft preparatory to landing, but there the resemblance ends. The contrast in subjects and surroundings is, in fact, a remarkable one—a European airliner about to touch down on its snow-clad home airport, and an American military trooper letting-down towards a surf-fringed Pacific island.

The airliner, a 47-seat Elizabethan of British European Airways, is depicted above the Calvert approach lights leading into Runway 28L at London Airport. Situated near B.E.A.'s new engineering base, the snow-blanched firs in the foreground form an incongruous oasis in the concrete desert which is London Airport today.

The trooper, a 106-seat R7V-1 Super Constellation of the United States Military Air Transport Service, is seen more than 7,000 miles from London—over Waikiki Beach, Honolulu, with the once-volcanic Diamond Head ("Mount Aloha") beneath its extended mainwheels. Aircraft of this type range across both Atlantic and Pacific Oceans to link American bases in the United States, Japan and Europe; this particular machine is assigned to Navy Squadron VR-7 at Hickam Field, Oahu.



DOUBLE MAMBA PROGRESS

Development History of the ASMD.1: Full Production at Ansty

THE problems of control of turboprop aircraft are many and complicated. Particularly so, one might suggest, in the case of Naval aircraft, which need absolute precision of control at all stages of carrier approaches and landings. And particularly so, where engine-stalling is possible, in the case of axial-flow engines.

A recent visit to the Ansty and Parkside, Coventry, factories of Armstrong Siddeley Motors, Ltd., enabled us to see for ourselves the tempo of Double Mamba super-priority production at present. Behind this production lies a background of solid development progress, more especially aimed at the intricate difficulties of engine control and handling.

The development history of the Double Mamba to date shows no radical changes in design. Problems similar to those experienced on all engines have been encountered, and have been overcome.

It was in September 1948 that development running of the Double Mamba began. One year later, the unit made its first flights, powering the Fairey GR.17. As running time increased and periodic-check intervals were extended, development snags, as in any aircraft or engine, became more evident.

The first main problem encountered was that of "scuffing" and wear on the reduction gears, more especially on the satellite-gear units. To overcome this, phosphating or "Parkerizing" of all gears was introduced; in addition to curing the scuffing and wear, this also increased the load capacity.

During 1950, a variation in r.p.m. due to oil-transfer leakage, mainly on the rear airscrew shaft, was countered by a tightening-up of clearances. Improvements in the airscrew itself, made by the Rotol company, also helped to overcome the r.p.m. wander.

An engine synchronizer for speed trimming up to ±180 r.p.m. was introduced at the beginning of 1952, and another modification made at about that time involved a re-staggering of compressor blades. This latter change, made before the engine went into production, was intended primarily to improve its power. Overheating of the combustion chambers subsequently occurred, however (presumably due to the resulting change in mass flow) and improvements were made to the design of the chambers.

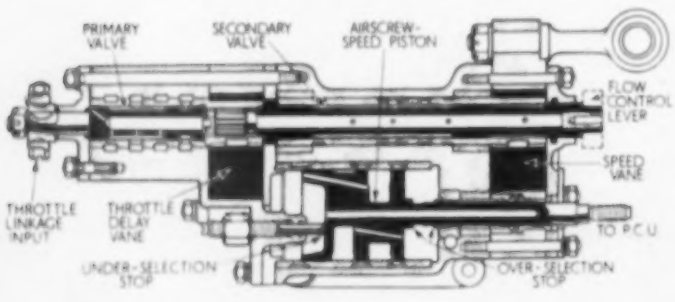
An impression of the changes made may be obtained from the sketch on the opposite page. The original primary air tubes, of curved "walking stick" type, proved liable to burning (as fuel adhered to the outside of the bends, the inside became hot), and so a change was made to a long, square-corner type. Vibration troubles led to an alteration in welding technique, and a shortening of the vaporizer tube.

Overheating was noticeable primarily in the outer casing of the combustion chamber (mainly opposite the four large mixing holes), where hot-spots were occurring. "Film cooling," by which a film of cool air was passed along the inner surface of the flame-tubes, was therefore adopted, in the form of three cooling bands. This deflector-type of film cooling was used in preference to a previous type, incorporating a "stepped-cylinder" flame-tube with corrugated spacing-strip, for reasons of simplicity, increased air space and ease of manufacture.

Other modifications included the use of a precision "low flow-number" jet (particularly advantageous at low temperatures), the replacing of the locating dimples between the end of the flame-tube and outer chamber by a continuous corrugated locating strip (to overcome fretting), and the use of a slightly "ovalized" tube. The flame-tube material now used is Immaculate 5, an austenitic stainless steel with 25 per cent nickel which has proved to be easily workable.

In May 1952 the Gannet's first carrier deck-landing trials took place, and in June the Double Mamba completed its 150-hr type test.

Further improvements were made during 1952-53 to the reduc-



The Mk 2 anticipator (engine control unit) not only temporarily selects a lower r.p.m., in the case of throttle advancement, in order to give a simultaneous coarsening of pitch and hence increase of thrust, but also restricts the rate of fuel-supply increase during a slam acceleration.

Advancement of the throttle rotates the primary valve and feeds oil to the delay vane, which then operates the secondary valve and the flow-control lever. The same movement causes hydraulic pressure to move the speed vane and to move the piston to the under-selection stop; the piston, connected to the p.c.u. (or c.s.u.) then gradually returns to the equilibrium position.

tion gear. Following roller-cage failures and track breakdown on the satellite unit (then a large-bore gear with an aluminium cage) a smaller bore (to increase stiffness, and so reduce deflection under load), and a strengthened steel cage were introduced, and an improvement in manufacturing accuracy enabled undercuts on tracks to be deleted. To eliminate pick-up on the steel cages, a 0.020in nickel cadmium liner was plated on to the inner face.

The first production Double Mamba underwent final tests and was delivered in January 1953. Gannets were handed over to the Navy in April 1954 for intensive flying trials, and it was during these trials that the danger of compressor-stalling (under certain conditions), which led to all Gannets being grounded for three months, was discovered.

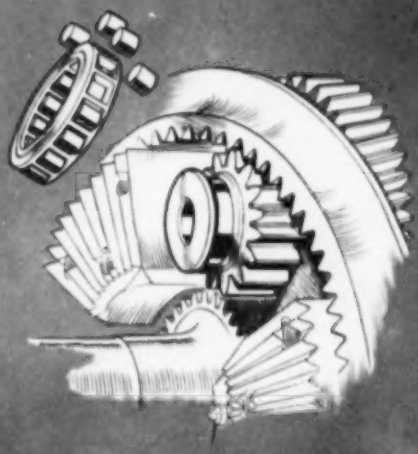
The nature of the problem encountered can best be understood in relation to the wider questions of turboprop control in general. A simple single-lever control would be that in which the fuel control unit and the airscrew speed control unit are directly connected to the pilot's throttle. This would be effective provided the pilot's lever were moved very slowly: in the case of more rapid movement, however, engine and airscrew inertia would cause engine speed to lag behind the selected speed, and their effect on airscrew pitch would cause oscillations about the required engine speed before the engine stabilized at the new selected conditions.

For the rapid-acceleration case, this system has three major disadvantages. The first response to throttle-opening is in the wrong sense (as pitch and thrust momentarily decrease instead of increasing); there is an appreciable time-lag before the thrust does increase; and some time elapses before the engine stabilizes and runs steadily at the new r.p.m. and thrust.

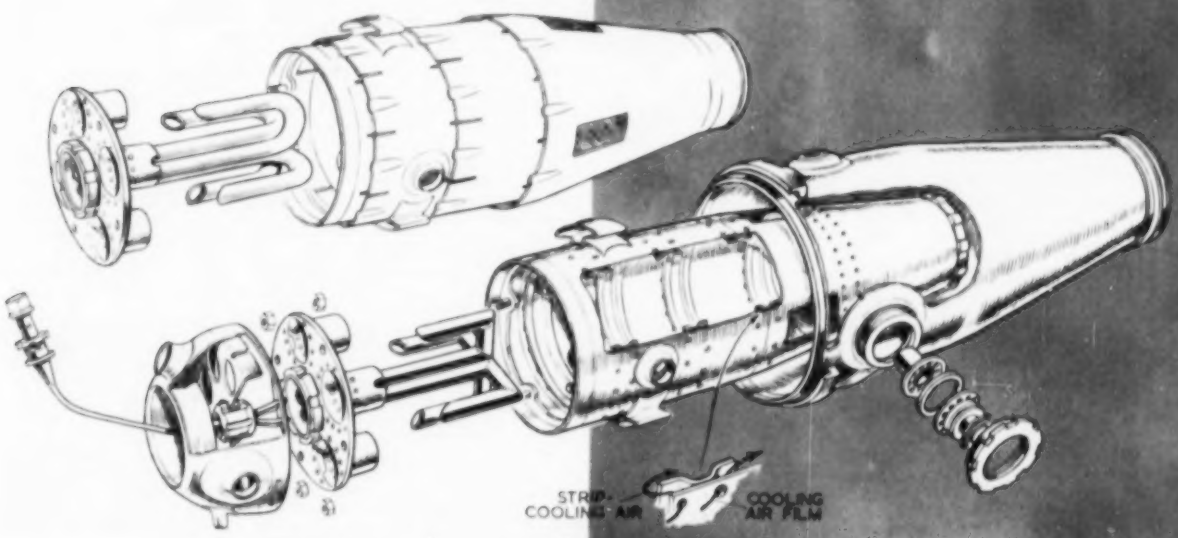
To avoid these defects, Armstrong Siddeley's single-lever control system incorporated a hydraulic servo between the pilot's lever and the c.s.u. This servo provided a differential rate of movement between the pilot's lever (still directly coupled to the fuel control unit) and the speed-selecting lever on the c.s.u. The effect of this device was to cause the selected r.p.m. to lag behind the movement of the pilot's lever, resulting in the increased thrust being achieved more rapidly, and in the elimination of the violent oscillation of engine speed and thrust.

Apart from the small lag in the response of thrust to movement of the pilot's lever, this system was found to give satisfactory engine-control and handling under all normal flight conditions. For a carrier-based aircraft, however, immediate response is necessary during the landing approach: thrust must fall to zero instantly when the pilot cuts the throttle, while full thrust must be achieved very rapidly in the event of a wave-off.

In any system in which the r.p.m. are changed at the same time as the power, however, the inertia of engine and airscrew during any sudden increase or decrease of power must inevitably cause a lag in response of airscrew thrust to throttle movement. Thus a logical step to improve the speed of this response is to operate the engine at constant speed over the power range.



Above, reduction-gear changes include the introduction of phosphating, a smaller satellite-gear bore, and cadmium-plated steel cages. Below, the original (upper) and present production types of combustion chamber on the ASMD.1. The ASMD.3 has an annular chamber.



In the Double Mamba production assembly shop at Anstey, individual Mamba "halves" are prepared for final assembly.

General view of part of the production assembly shop. The ASMD.1 engines for the Gannet are rated at 2,850 e.h.p.

DOUBLE MAMBA PROGRESS . . .

To run the engine at constant speed, it is not sufficient merely to lock the selected speed at the desired value, for an appreciable delay in thrust application and oscillation about the selected value would take place. To minimize the change in r.p.m. during a power increase it is necessary to coarsen the airscrew pitch at the same time as more fuel is supplied to the engine, thus immediately increasing its power output.

As the c.s.u. changes airscrew pitch only when a difference occurs between actual and selected r.p.m., a lower r.p.m. value must be selected temporarily. This arrangement ensures that, when higher power is demanded, the airscrew immediately begins coarsening pitch, thus increasing thrust without waiting for any other changes to occur. Similarly, on reducing power, the airscrew immediately moves towards fine pitch, reducing thrust.

These general principles having been applied to the Double Mamba, the change from variable-speed to constant-speed operation was made early in the engine's life. The original technique had involved using minimum pitch up to 13,000 r.p.m., followed by a speed change directly proportional to power. The second method was to continue in minimum pitch up to 14,500 r.p.m., then to increase power at this constant speed as high as intermediate or climb power. At this power, speed was increased to 15,000 r.p.m., at which speed the final increase to take-off power was made.

This constant-speed technique was clearly an improvement, and seemed to cure the compressor-stalling which had previously been experienced. Experience during the intensive flying trials of the Gannets last year, however, pointed to the fact that the operating line of the engine was critically close to its stall-line in the region of 13,000 to 14,000 r.p.m. On reducing power, airscrew speed could underswing momentarily to a value below that at which the engine would accept a high fuel-flow without stalling.

It had been appreciated for some time by Armstrong Siddeley that the safety margin in the region of 13-14,000 r.p.m. was not very large, but careful attention to control adjustments had been paid during engine development flying, and it had been believed that production engines would be satisfactory.

Following the instances of engine-stalling during flight, Gannets were grounded until the trouble had been cured. One possible solution would have been to increase the engine-speed rating to 15,000/15,500 from 14,500/15,000, but experience showed that mechanical troubles might be encountered in the reduction gear and its life reduced if this were done.

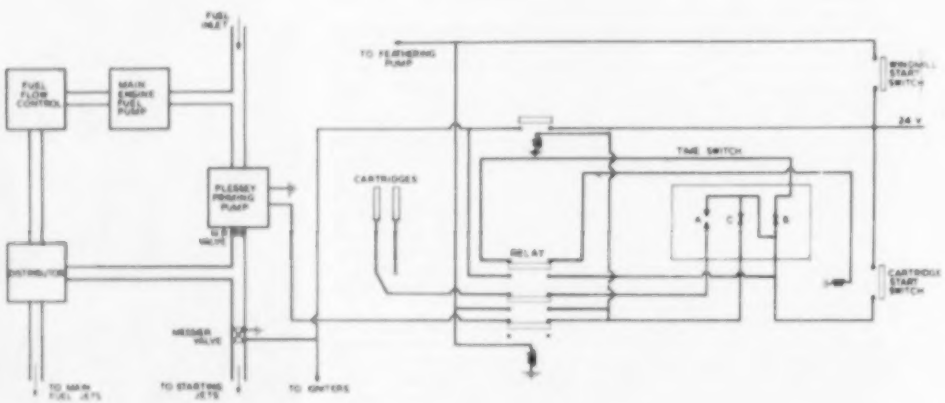
The main change, therefore, was to alter the engine rating to 15,000/15,000, i.e., to adopt the technique whereby, once 15,000 r.p.m. had been achieved in minimum pitch, all power was added at this speed. In addition, the engine control unit (known as the anticipator) was modified by the addition of a device to control the rate at which the fuel-supply increase is applied during a slam acceleration. On the first type of anticipator, there had been no restriction on the speed with which the pilot could accelerate and increase fuel-flow. The Mk 2 anticipator, while still not restricting the movement of the pilot's lever, does delay the increase of fuel-flow to the engine.

With the increase in operating speed to 15,000 r.p.m. came a modification to decrease the stalling speed of the compressor. As a result of aerodynamic tests, a 3-deg re-staggering of the 2nd to 8th stage stator-blades was incorporated, together with a 5-deg re-staggering of the inlet guide vanes. A reduction in stalling speed from about 14,000 to about 13,500 r.p.m. was thereby accomplished. By these means the engine operating line was moved sufficiently far away from the critical region to avoid further stalling trouble, and the Naval Gannets recommenced flying at the beginning of December.

The effect of intake temperature on the "corrected r.p.m." value, and hence on the compressor stalling speed, appears to be one major factor in explaining why the stalling troubles were not experienced at an earlier stage in the engine's development. Although one aircraft had carried out warm-weather flight trials in Malta, the majority of development flight-testing had been in cold-weather conditions. Since the Gannets returned to service, one aircraft—and two Double Mambas—have successfully completed further flight trials under warm conditions at Khartoum.

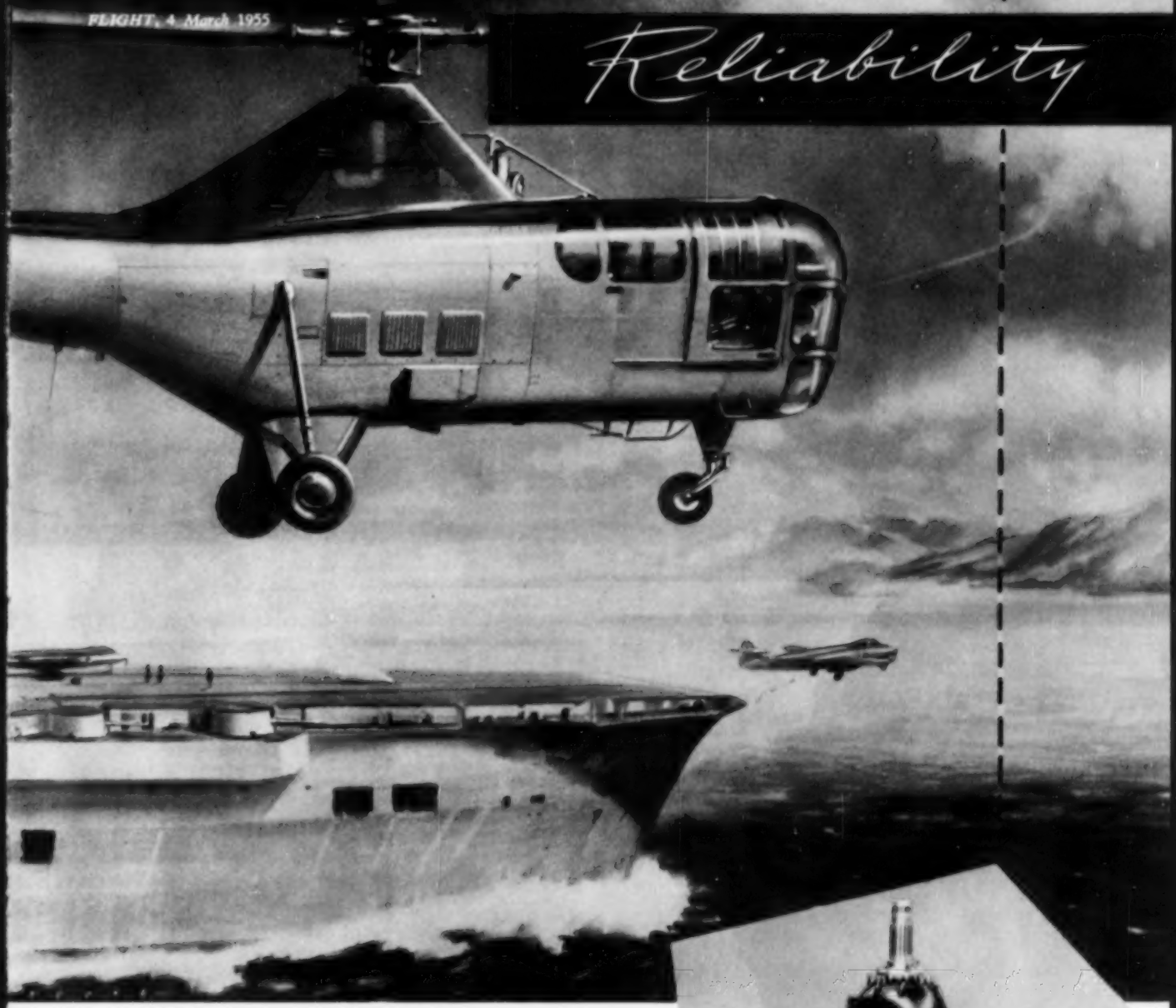
The starter system used for the Gannet's Double Mamba is illustrated in the diagram below. Normally the first Mamba of a double unit to be started uses the cartridge method, and then its slipstream is used to windmill-start the second.

For a cartridge start, the fuel isolator is opened and the switch is operated, starting time switch, priming pump and ignition. After 2 secs, contacts "A" close, firing the cartridge; after 7 secs,

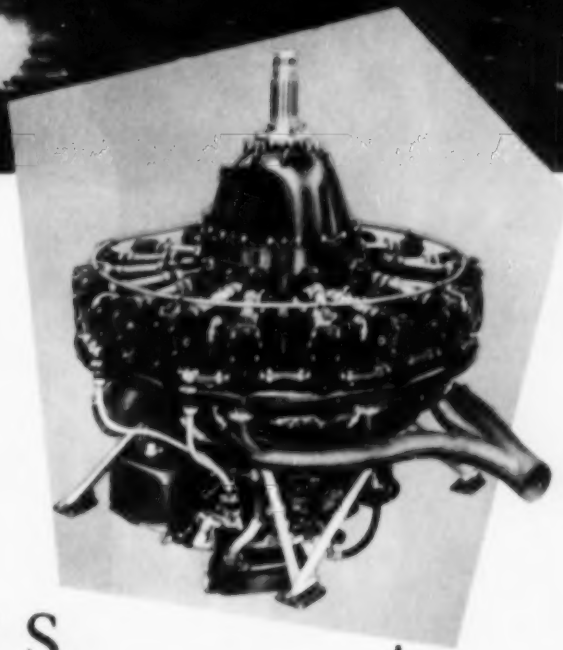


Starting system of the Double Mamba. Fuel lines are primed and igniters lit for 2 sec before the cartridge is fired. After either the port or starboard Mamba has been cartridge-started, the windmill-start method (used also for in-flight re-starting) is utilized for the second unit. A description of the sequence of operation is given in the article.

Reliability



Powered by the ALVIS LEONIDES Helicopter Engine, the Dragonfly serves the Royal Navy as a quick and effective means of rescue during deck landings and take-offs, besides fulfilling the routine requirements of inter-ship and ship-to-shore communications. Light and compact in design the Alvis Leonides Helicopter Engine is readily adapted to single or twin-engined installations. 520 b.h.p., 9-cylinder air-cooled radial engine. Weight complete 645 lb. Power/weight ratio 1.24 lb. per b.h.p. Overall diameter 41.5 inches.



ALVIS

LEONIDES

ALVIS LIMITED · COVENTRY ENGLAND

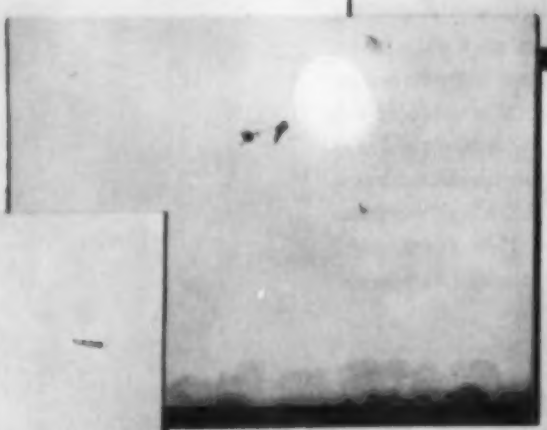
Martin–Baker

AIRCRAFT COMPANY LIMITED

These photographs show an actual ejection on the run-way. The aircraft is taking off at 120 knots.

This test was carried out with the 80 feet per second long stroke ejection gun. No other ejection seat in the world is capable of such a performance.

All designed features patented in the principal countries of the world.



DOUBLE MAMBA PROGRESS...

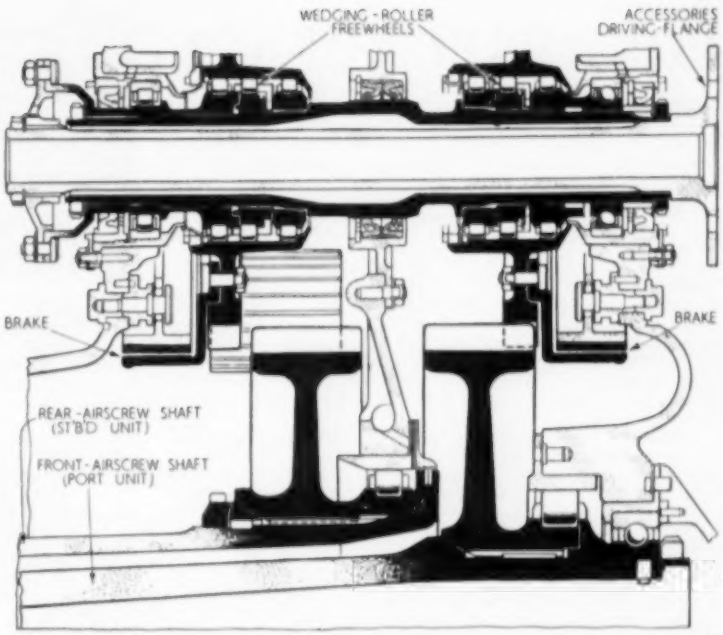
contacts "C" open, cutting off ignition and priming pump; and after 15 secs, contacts "B" open, releasing switch solenoid, and the circuit is ready for further use.

In the case of a windmill start, the fuel isolator is opened (selecting "unfeather" on the c.s.u.) and the "windmill-start" switch is operated, energizing the relay (allowing feed to ignition only) and starting the time switch. The propeller unfeathers and engine speed builds up and, after 7 secs, contacts "C" open, cutting off ignition and relay solenoid.

As indicated, the bulk of fuel required during a cartridge start is provided by the Plessey priming pump, feeding direct to the starting jets. The actual Rotax turbo-starter develops 135 h.p., has a maximum turbine speed of approximately 40,000 r.p.m., and an operating pressure of 1,000 lb/sq in.

Each cartridge has a burning time of only 3.2 sec and, as the self-sustaining speed of the engine is approximately 4,500 r.p.m., it has normally been found necessary to fire two in succession to achieve this speed at temperatures of 8 deg C or less.

One of the earlier modifications on the Double Mamba was the introduction of the airscrew brake, shown (right) in section. This was essential for carrier operation, with the need to stop the airscrew rotation quickly. An average stopping time of 40-50 sec was reduced to 10-12 sec using the brake, which operates on the accessory drive shaft. An accumulator is provided so that the unit acts in addition as a parking brake.



The need to stop airscrew rotation quickly after shutdown, for carrier-designed aircraft such as the Gannet, led to the early incorporation in the Double Mamba of a double airscrew brake, shown here in simplified section. The brake is of Lockheed design, and is carried on the accessory drive shaft.

The automatic jet-pipe-temperature control is based on the Wheatstone bridge principle. The voltages indicated by the thermocouples in the jet pipe are balanced against datum potentials corresponding to specified temperatures, and a magnetic amplifier is incorporated, its output operating a spill-valve in the fuel circuit which bleeds off fuel until balance is achieved.

The selection of J.P.T. datum-points was made by moving a brush-type wiper over various segments. Originally these segments corresponded to 700 deg C (starting), 530 deg C (cruise), 550 deg C (climb) and 580 deg C (take-off). The 550 deg position is no longer used, and steps are now in hand to dispense with the selector unit altogether, retaining only the 580 deg datum operative as an override on take-off. Improvements have been made during the development period towards maintaining good electrical contact between the rubbing strips in the selector unit, especially important since the potential differences involved were only of the order of a few microvolts.

The type of Double Mamba at present in production for the Gannet is the ASMD.1, basically comprising two Mamba ASM.3s. It is hoped to type test the more powerful ASMD.3 (consisting of two annular-chamber ASM.5s) during the first half of this year, and a further increase in power is foreshadowed by the ASMD.4, which will presumably use two ASM.6s. Excluding Service hours, the ASMD.1 has 15,000hrs development running to date.

FORTHCOMING EVENTS

Mar. 5. British Interplanetary Society: "Radio Exploration of Space," by R. C. Jennison, B.Sc.
Mar. 5. British Interplanetary Society (Midlands branch): "The Path to Space Travel," by K. W. Gatland.
Mar. 5. The Cranfield Society: Annual dinner and annual general meeting.
Mar. 9. R.Ae.S. Graduates and Students Section: Annual general meeting and film show ("The Society Overseas," by A. M. Ballantyne, T.D., Ph.D., A.F.R.Ae.S.).
Mar. 9. Royal United Service Institution. "Long-distance High-speed Flying," by W/C. L. M. Hodges, D.S.O., O.B.E., D.F.C.
Mar. 10. British Institution of Radio Engineers (Scottish section): "Computing Circuits in Flight Simulators," by R. A. Marvin, B.A.
Mar. 10. Institute of Welding: "Titanium: Welding and Other Joining Methods," by D. C. Moore (at Bristol Aeroplane Co., Ltd.).
Mar. 10. R.Ae.S. Main Lecture: "Structural Safety," by Prof. A. G. Pugsley, O.B.E., D.Sc., F.R.Ae.S. (at Preston).
Mar. 11. Helicopter Association: "Helicopter Maintenance," by J. H. Willins, A.M.I.C.E.
Mar. 11. British Gliding Association: Ball, Londonderry House.
Mar. 11. Institute of the Aeronautical Sciences: National flight propulsion meeting, Cleveland.
Mar. 14. Royal Society of Arts: "The Mechanical Properties of Metals—(1) Tensile Properties," by Prof. Hugh Ford, D.Sc., Ph.D.
Mar. 15. R.Ae.S. Section lecture: "Production of Large Forgings," by C. Smith, F.I.M., and J. Crowther, M.Sc., F.I.M.
Mar. 16. R.Ae.C.: Dinner for King's Cup winners.
Mar. 17. R.Ae.S.: Eighth Louis Blériot Lecture, "Making Aeroplanes Independent of Runways," by M. Georges Hereil.
Mar. 18. Institute of Navigation: "Problems in Space Travel," by Dr. J. G. Porter.
Mar. 18. Institute of Transport: Annual Dinner.
Mar. 19. Surrey Flying Club: Opening of new club-house, Croydon.
Mar. 21. Royal Society of Arts: "The Mechanical Properties of Metals—(2) Creep," by Prof. E. N. da C. Andrade, D.Sc., Ph.D., LL.D., F.R.S.
Mar. 23. R.Ae.C.: Annual general meeting.
Mar. 24. R.Ae.S. Main lecture: "Analogue Computing Applied to Aeronautical Problems," by K. V. Diprose, B.A.
Mar. 25 College of Aeronautics Senior Common Room Society: Annual dinner.
Mar. 25. Institute of Welding: Annual dinner and ladies' night.
Mar. 26. Rugby, Twickenham: R.A.F. v. Army.
Mar. 28. Royal Society of Arts: "The Mechanical Properties of Metals—(3) Fatigue," by Maj. P. L. Teed, F.R.Ae.S.
Mar. 29. R.Ae.C.: Film show.
Mar. 29. R.Ae.S. Graduates and Students Section: "Atomic Energy," by Prof. J. Rotblat.
Mar. 30. British Institution of Radio Engineers: Discussion: "The Maintainability of Service Equipment." (Speakers include W/C. G. C. Godfrey, for R.A.F.)
Mar. 31. R.Ae.S. Section lecture: "Aerial Survey in the Economic Development of a Country," by T. D. Weatherhead, O.B.E., M.A.
Apr. 1-3. Aslib Aeronautical Group: Annual conference, Cranfield.
Apr. 2. British Interplanetary Society: "Problems of Heat Transfer in Rocket Motors," by H. Ziebland, Dipl. Ing.
Sept. 5-11. S.B.A.C. Show, Farnborough.

R.Ae.S. Branch Fixtures (to April 6th):—

Mar. 7, Glasgow, "Design Criteria for Fatigue of Wings," by Dr. P. B. Walker; *Halton,* Films, "How an Aeroplane Flies"; *Henlow,* Student members' lectures. *Mar. 8, Bristol,* Second Barnwell Memorial Lecture, by Walter Tye. *Mar. 10, Yeovil,* "Cabin Air Conditioning." *Mar. 12, Birmingham,* Annual dinner. *Mar. 14, Halton,* "Cabin Pressurization," by F. W. Michael. *Mar. 15, Manchester,* "Helicopters," by C. S. Hislop; *Belfast,* "Aerial Photography," by Charles Brown.

Mar. 16, Southampton, "The A.R.A. Wind Tunnel," by R. Hills. *Mar. 18, Birmingham,* "Trends in Development of Aircraft Electrical and Starting Systems," by R. H. Woodall. *Mar. 21, Halton,* Branch night; *Henlow,* Film, "Hell's Angels"; *Yeovil,* "Production Problems on Helicopters," by D. C. Collins. *Mar. 22, Bristol,* "Some Problems of Bomber Design," by D. Keith-Lucas. *Mar. 23, Cheltenham,* "Some Problems of Bomber Design," by D. Keith-Lucas; *Luton,* Annual general meeting. *Mar. 24, Isle of Wight,* Branch prize lectures.

Mar. 25, Southampton, Annual dance. *Mar. 28, Halton,* Junior members' night. *Mar. 30, Brough,* Annual general meeting and film show. *April 5, Boscombe Down,* "The Light Fighter," by W. E. W. Petter; *Glasgow,* "The Twin Pioneer, Design, Production and Test Flying," by T. B. Lyon, J. Hislop and N. J. Capper. *April 6, Chester,* "Operation of Jet-engined Aircraft"; *Luton,* "Aerial Photography," by Russell Adams; *Weybridge,* "Some Maintenance Aspects of Viscount Operation," by E. R. Major.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

The Hawker Fury referred to in the letter from Mr. S. Davies.

High-lift Generation

THE article by Mr. A. R. Weyl on "High-Lift Generation," in *Flight* for January 7th and 14th, was interesting not only in itself, but also on account of the comparisons to be drawn with low Reynolds number aerodynamics. Mr. Weyl omitted to state (though perhaps correctly so, as it was self-evident) that the devices described are applicable only at Reynolds numbers of full-size aircraft.

However, it is interesting to review briefly the practical methods for lift-augmentation used in low Reynolds number aerodynamics, i.e., in "free" aeromodelling (normally in the range between 7,000, for indoor models, and about 150,000, for large powered free-flight models—tethered speed models reach some 250,000). As the operating conditions of the aerofoils of many models, especially those of high-performance sailplanes, fall within their sub-critical region, characterized by a laminar boundary layer and very low L/D ratios, it is often necessary to introduce energy through artificial turbulence into the boundary layer, as only this ensures an adequate flow pattern over the aerofoil without separation of the main airflow. This is generally done in one or both of two ways —either by using special aerofoil sections which operate, even at low Reynolds numbers, in over-critical conditions, or by using artificial turbulence generators on, near, or in front of the leading edge. Both methods are in use today.

As to aerofoils, low fineness-ratios (e.g., 4.4 per cent on a section evolved by the writer), moderate to high centre-line camber and sharp trailing edges are considered necessary in model sailplane wings.

Turbulence in the boundary layer is generated mostly with the aid of the following devices. The turbulence wire is the one mostly used, and, correctly placed in front of the leading edge, gives very good results, increasing C_L values by up to 300 per cent on normal aerofoils (e.g. from 0.45 to 1.3—which is considered high in a model!—for a given constant C_D at RN = 80,000 on a Clark Y type aerofoil). Sharp-edged turbulence strips are glued, in some cases, on to the upper surface just behind the leading edge. Sometimes sawdust is sprinkled on the upper surface, which even has been painted black, at least in two cases, in order to turbulate the boundary layer by heat convection!

Jerusalem, Israel. N. KADMON.

R.A.F. Bands Strike a Dull Note

I AM surprised that the Air Council have not done something to improve the R.A.F. Central Band and the R.A.F. College, Cranwell, Band. These bands, in my view, are hopeless to march to and deplorable to listen to.

A number of suggestions could be made, including the following: establishment of the ranks of band sergeant and bandmaster in the R.A.F.; formation of R.A.F. and W.R.A.F. brass bands for every unit of sufficient size; the holding of R.A.F. brass-band contests; the composition of a quick march and slow march for each squadron of the Service, as in the Army regiments; formation of an R.A.F. school of music to teach airmen and airwomen full theory and practice; and establishment of a boy entrant and apprentice scheme for the trade of R.A.F. musician.

There are thousands of airmen in the R.A.F. today who can play brass band instruments, but they are refused permission to enter station voluntary bands or established bands in the R.A.F. They are not allowed to practise on the station and they are refused permission to play in civilian bands. This is a remarkable contrast to the Service encouragement of sport and similar occupations.

In conclusion, it may be added that some years ago three Norfolk brass band instrumentalists went to Uxbridge to be examined by the R.A.F. Central Band trade test board. They were turned down. Subsequently, after auditions at the Royal Military School of Music, they passed out with 100 per cent marks on the whole musical curriculum, and today they are commissioned officers and directors of music. One is in charge of the R.C.A.F. Central Band, another of the R.C.A.F. Training Command Band and the third of the R.A.A.F. Central Band. I personally was told that I was "no good as a musician," but I am now a tuba player in the B.B.C. Scottish Orchestra.

Peterborough, Northants. W. S. WHALES.

Collecting the Empties

THE implication, in a recent statement by the Under-Secretary for Air, that Hunters are to be fitted with external link and cartridge containers suggests that a lesson learned as long ago as the 1930s may have been forgotten. I refer to the fitting, as illustrated in the enclosed photograph, of collector boxes on the Hawker Fury biplanes in R.A.F. service. Subsequent Hawker fighters, of course, had wing-mounted guns, and presumably the same problems did not arise.

Broadstairs, Kent. S. DAVIES.

Pressure Cabins

RESULTING from the Comet Inquiry, one point would appear to be highly relevant in that problems of construction which have always been present during the fabrication and shaping of metal into unnatural attitudes becomes magnified as we enter the region of rare air which necessitates the boosting of cabin internal air pressures beyond a given differential.

I feel that we could safely categorize high-flying commercial aircraft as any machines with normal differential pressures above 5.45 lb/sq in, giving us around the 8,000ft cabin altitude at 25,000ft.

For reasons of fuel consumption alone, all pure-jet commercial aircraft will automatically be outside this range. Comet Series 1 aircraft, the forerunners of a new era in commercial flying from all aspects (i.e., block-to-block speed, passenger comfort and ease of *en route* maintenance) cruise at up to 39-40,000ft altitude, with maximum normal cabin pressures at about 8.25 lb/sq in. Series 2 and 3 aircraft, with superior performance and range will (possibly due to the problems surrounding cruise control of the jet engine, and in order to hold speeds within the desired Mach number) wish to exceed such altitudes as 40,000ft as all-up weight decreases with fuel burn-off for the longer stage-lengths.

Later on it may even suit us to fly higher still, with further increases in cabin pressure differentials.

No one can possibly be in any doubt that we are able to design satisfactorily a modern fuselage that will continuously stand a pressure of 8-10 lb/sq in for any safe economical life which the planners may lay down having regard to capital outlay.

Then surely the only problem is the one already existing with all the mechanics of aviation, i.e., strength/weight ratio. In simple terms, were we to construct a Series I Comet with a pressure cabin and general wing construction so robust that "prepared-for-service weight" began to approach to maximum all-up weight, this in its new form would be an extremely safe aircraft with a life far beyond any practical requirement, but commercially valueless.

From this we surely see that it is only a matter of intelligent approach to the subject. We do not yet know what new steps our aircraft designers will take in this matter. Methods of fabrication may have to be revised, metal gauge stepped up, steels be introduced; and one's mind automatically strays to forms of geodetic construction where skin thicknesses could be held within reason by two or three laminations wrapped in varying directions for grain flow stagger to give the equivalent of a plywood in metal.

It would also appear advisable to keep cut-outs to a minimum, and to this end the modern passenger, with the aid of pleasing aircraft interior layout, may have to be enticed away from the window-per-seat-row idea.

Technique in modern aircraft construction, both military and civil, tends towards machining from the solid, of quite large sections of aircraft, on giant millers. A good example of this is a 32in × 4in × 1½in inner section of the underwing surface, port and starboard, of the Lockheed Super Constellation. There may well be some future for such fabrication along cabin windows and escape hatches of the modern high-flying pressure cabin.

I wonder whether we are approaching a point where fuselage designs will have to be standardized and serialized and pressure cabins built and tested to cover the 40-50,000ft requirement for 110.000, 210,000 lb m.a.u.w. requirement, available for release to builders of modern aircraft. To me this would not appear so unlikely. There must be an optimum aerodynamically and statically efficient shape for a fuselage and this is rather borne out by a rapid glance at the Boeing 707 and Comet Series.

Heliopolis, Egypt. J. DREW.

Where the GNAT LIGHT FIGHTER *scores*

A powered tailplane, combined with a high thrust-weight ratio, makes possible an exceptionally good rate of sustained turn.
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Similarly, on the basis of

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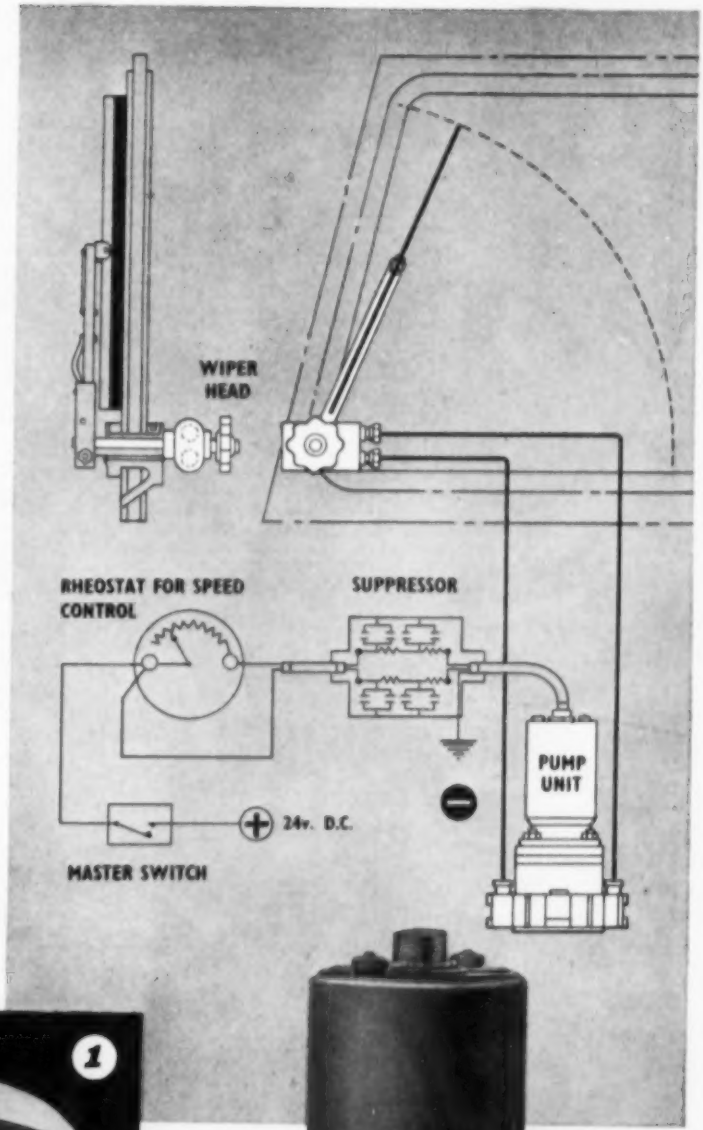
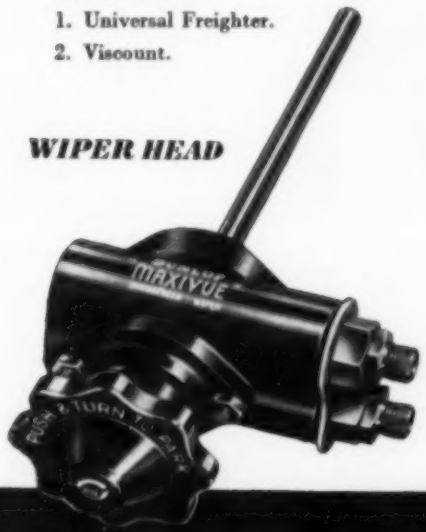
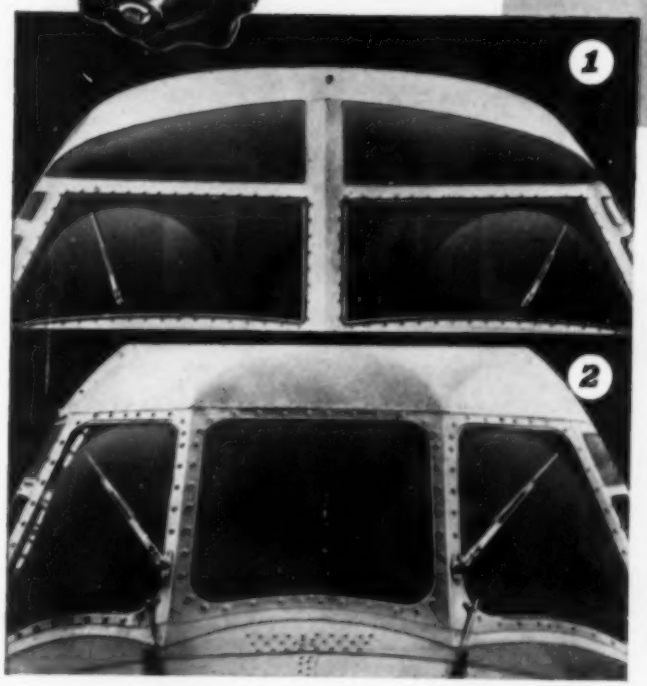
1. Universal Freighter.
2. Viscount.

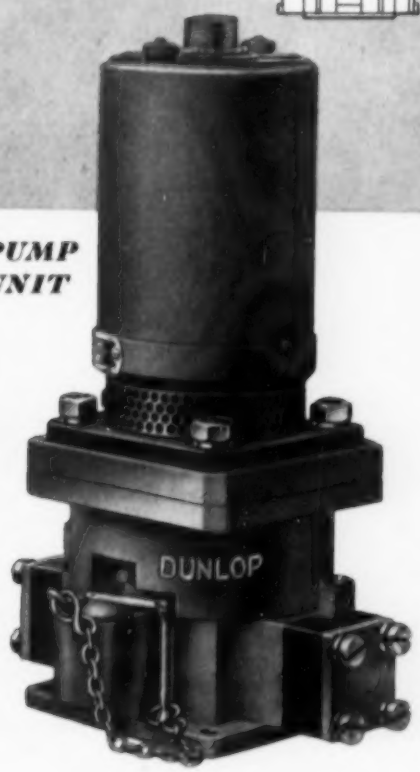


WIPER HEAD





PUMP UNIT



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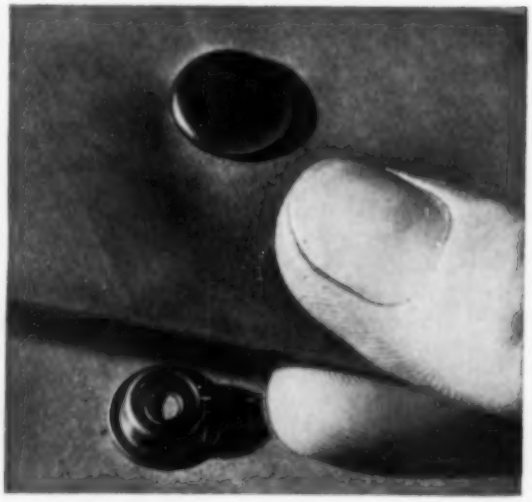

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CORRESPONDENCE . . .

JET LIFT RAISES A CONTROVERSY

IN *Flight* of February 4th you have produced a very interesting article on jet lift, but I cannot leave some of your proposals unchallenged.

You write of the weight of lifting motors being less than the saving in wing and undercarriage weight. This is certainly possible, but with a specific fuel consumption of 1.5 lb/hr/lb the weight of the extra fuel required for take-off and landing could easily be 10 to 15 per cent of the all-up weight.

You also write of wing loadings of about 300 lb/sq ft associated with Mach numbers of 1.5 and altitudes of 60,000ft. I suggest that this speed and altitude would not be achieved with a wing loading of much more than 80 lb/sq ft on a straight thin wing or about 50 lb/sq ft on a highly swept delta. With these wing loadings demanded for the cruising condition, the prospects of jet lift begin to fade, since the take-off and landing problem is not really severe.

Another point with which I cannot agree is the suggestion that the same engines might be used for take-off and cruise since "some aircraft designed for Mach numbers over two will need thrust exceeding their all-up weight." Unless this sort of aircraft can be designed to achieve a cruising weight/thrust ratio of at least 4, it can scarcely be considered as a reasonable project and it is becoming increasingly apparent that engines designed for these high speeds and altitudes cannot at the same time give very high static thrusts; in fact, they must ultimately approach ramjet performance.

I think that Rolls-Royce are absolutely right in their contention that the two engines—lifting and thrusting—should be of different design.

I do not wish to give the impression that I am at all critical of the great stride forward which Rolls-Royce have made, but I am not at all sure that the future of jet lift lies in the fields which your article suggests.

Belfast. SLIPSTICK.

SETTING aside the more startling of the statements made by the author of "Jet Lift"—such as that the pressure distribution over a wing is a Newtonian "reaction" to the deflection of the relative airflow, or that jet lift involves no deflection of the surrounding atmosphere—his analysis of a theoretical aircraft to his own specification is optimistic and disingenuous.

For some reason, he stipulates that his aircraft should remain jet-borne until it reached a speed of 150 kt, at which speed the wing would begin to take its share of the burden. But as the wing would not be called upon to support any weight at all at take-off, its loading would not be 300 lb/sq ft, as he says, but nil; it would never be stalled, and would therefore be able to generate lift immediately it started to move forwards. As the battery of lift-turbines would cost something of the order of £5 per second to run, one hopes that the pilot would start to cut them out at the earliest possible moment.

The author light-heartedly dismisses the problem of the fuel consumption of his lift-turbines by saying that it would be "of little importance for such short duration." His large aircraft would have fifty lift-turbines of 10,000 lb thrust each, so that on his own figures their gross consumption would amount to 750,000 lb/hr—enough fuel to run a diesel car from London to Edinburgh and back five thousand times, or fifteen times the distance from the earth to the moon. To accelerate the 300,000 lb aircraft from rest to 150 kt would take something more than 20 seconds, so that if we allow him a total of 30 seconds' running time for the lift-turbines at take-off we are being generous to him.

For landing, of course, other problems arise. He has conveniently overlooked the fact that when his aircraft's speed has fallen to 150 kt and it has once again become wholly jet-borne, it has still to be brought to rest, and to be manœuvred directly over the landing-point. If we make him a present of fifty per cent reverse thrust from his main engines without weight penalty, it will still, I think, be generous if we allow as little as 60 seconds for this process. The actual let-down must obviously be performed more gingerly than the take-off: let us say 75 seconds for landing, or a minimum of 1¼ minutes' running-time per flight.

There is another point to be considered. When the lift-turbine fuel is exhausted, we have an aeroplane whose minimum safe speed is about 200 kt, with almost certainly vicious stall characteristics, an inadequate undercarriage, and, by hypothesis, no runway to land on, so that disaster is comfortably assured. Before allowing this potential flying lethal-chamber to take the air one hopes that the responsible authorities would insist upon at least a 100 per cent reserve of lift-turbine fuel being carried, so that we have to allow for not less than 3½ minutes' running-time. This entails the carrying of 44,000 lb of fuel, without allowing for the weight of tanks, etc.—a nasty slice out of the useful load of a 300,000 lb aircraft, even if we have saved the weight of the turbines themselves by constructional simplification.

Of course, with a cruising speed of Mach 1.5 the fuel requirements for the main engines will be prodigious, but we cannot depend upon *their* reserve supply to feed the lift-turbines, on the grounds that by the time the latter are brought into use the possibility of diversion no longer exists. The aircraft may already have been diverted and the reserve propulsive fuel been expended.

Let us examine this remarkable aircraft a little more closely. It will hardly be suitable for short stages; let us fly it from London to New York non-stop. The main engines have a total thrust of 120,000 lb and give it a cruising speed of Mach 1.5 at 60,000ft—say, 1,000 kt. For the New York trip it will have to carry fuel for not less than 3½ hours' running, and if we are very generous we may allow the engines a specific fuel consumption of 0.5 lb/hr/lb. This amounts to 210,000 lb of fuel. The installed weight of the main engines can hardly be less than 20,000 lb; we know that the weight of the lift-turbines is 50,000 lb, and of their fuel, 44,000 lb. Thus the weight of engines and fuel alone amounts to 324,000 lb, which is a high figure for an aircraft of 300,000 lb all-up weight! It is true that I have assumed that the main engines are run at full power continuously, but as the aircraft is to cruise at Mach 1.5 with less than the equivalent thrust of a Hunter or Sabre I do not think this is unreasonable.

I am not trying to belittle the possibilities of jet lift. No doubt research into this question is well worth while; but one may be forgiven for hoping that your contributor will not be in charge of it.

Horning, Norfolk. G. YOUNG.

Comment on the two foregoing letters, by the author of "Jet Lift," is as follows:—

Jet lift is going to require a considerable re-orientation of thought; aircraft of this type cannot be considered as conventional fixed-wing machines with an auxiliary device added.

"Slipstick" is naturally loth to envisage large aircraft with missile-like wing loadings; but the values he quotes are not *demanded* for the cruising condition. Incidentally, I did not advocate the use of one set of engines for both lift and forward flight; my comment was that ". . . the disadvantages almost certainly outweigh the advantages."

W/C. Young's letter does him less than justice; his first two paragraphs are pure quibbles, which may be left to readers to assess. He actually misquotes the article; after "jet lift involves no deflection of the surrounding atmosphere," the words "*per se*" appeared. *Of course* there is deflection of the whole neighbourhood; but it has no effect on the thrust, and, if compressed air were fed to the engine from a bottle, the jet would work equally well (better, in fact) *in vacuo*. It is also generally understood that wing loadings are not calculated for aircraft at rest; as for the "wing . . . would never be stalled," W/C. Young can try some sums assuming an angle of attack of minus 90 deg.

It seems that his own calculations are at fault. Had he seen the "Bedstead" film, he would not suppose that lift-jets are kept at full throttle. Actually, to support 300,000 lb, engines working at an s.f.c. of 1.5 lb/hr/lb demand an hourly consumption of 450,000 lb, not 750,000. Allowing for gradual throttling back, the mean lift-fuel consumption amounts to 100 lb/sec, or 3,000 lb for W/C. Young's time-value. It seems to have escaped his notice that, at landing, the aircraft would be much lighter; again taking his time estimate, the fuel required for landing, with 100 per cent allowance, would be 10,000 lb. The total lift-fuel thus comes to 13,000 lb.

One of the obvious advantages of the jet-lift aircraft is that it does not need a fuel allowance for stacking and diversion. In a conventional aircraft of the size considered, such an allowance might well exceed 30,000 lb.

The penultimate paragraph of the letter suggests that W/C. Young is unused to calculations of this type. It is also strange that he should take the sea-level thrust rating (30,000 lb) as the high-altitude cruising thrust. His mention of the Hunter and Sabre, both conventional "winged" aircraft, implies that he has missed the point of the new development.

CORRESPONDENCE IN BRIEF

ON the "Here and There" page of *Flight* for February 18th we told the story of a reader who, on a journey through Norway in a R.N.A.F. Dakota, occupied a seat in the fuselage of a Klemm Kl 35, which was being carried as cargo. The correspondent wondered if he could claim to be "the first civilian to land in two aircraft at the same time." Mr. J. Rasmussen, of Vickers-Armstrongs, Ltd. (Supermarine Works), now writes recalling a similar occurrence in 1945, when he also was travelling in a Dakota, which on this occasion was transporting a Spitfire from Burma to India. The incident was the subject of a photograph published in *Flight* for December 4th, 1947.

B-52 PRODUCTION

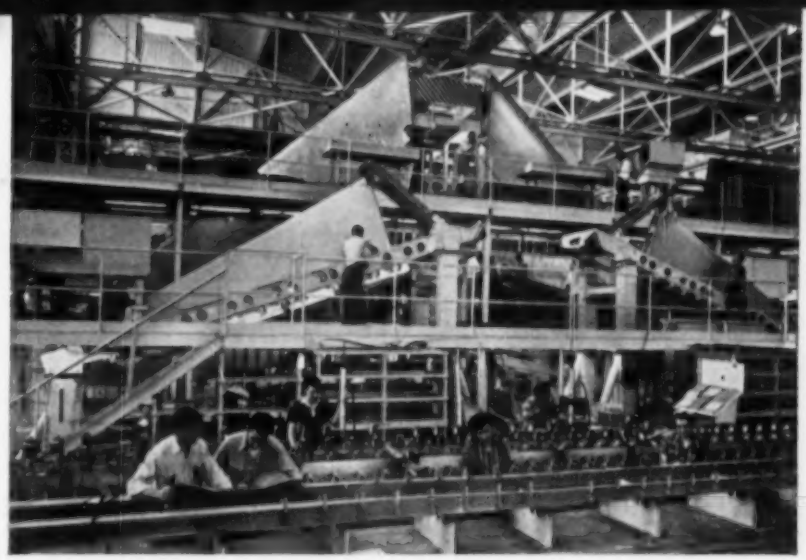
TAKEN recently in the Seattle plant of the Boeing Airplane Company, these photographs show some facets of the manufacture of the largest and most expensive aeroplane in the world currently in production, the Boeing B-52A Stratofortress.

Although a great deal of the B-52 airframe is sub-contracted, Boeing manufacture many items themselves and employ a number of unusual techniques. The top photograph on the opposite page shows the manufacture of tail units in vertical jigs, three storeys high. A considerable amount of the larger jigging is manufactured in reinforced concrete, this technique having been discussed in the February 1954 issue of our associated journal *Aircraft Production*. Although the airframe of the B-52 is extremely large the manufacturing tolerances are of an order previously associated only with high-speed fighters. On the other hand, skin as thick as that on the wing of the B-47 (up to ¾in) is not used, for the Stratofortress has a fundamentally different type of wing employing thinner skin.

The middle photograph on the opposite page, taken earlier than the others, shows the manufacture of the first two production machines. The nearer aircraft awaits its flaps, the guide rails for which can be seen, its flipper ailerons (fitted in the cut-out portion in the trailing edge) and spoilers (inserted in sections behind the rear spar in the recesses visible on the starboard wing). Outer wing panels and tail sections are added at a later stage. Below, left, are seen three nose sections being assembled in their two-storey jigs, something like 24 employees being engaged upon each section at the same time. The large roof hatches for the two pilots' ejection seats are in evidence, the use of multiple ejection-seats being unusual. The B-52 is operated by a flight crew of six.

The first production machine was "rolled-out" on March 18th last year, since when a considerable number of aircraft have been completed. Each machine is taken out of the factory at a scheduled hour irrespective of its condition; all the work remaining to be done on the aircraft—including installation of all military equipment—is then carried out on what the company term the "pre-flight line," which is shown at the foot of the opposite page. The aircraft at the head of the line when this photograph was taken are seen to be short of radar and power units. The large heading photograph shows a B-52A being "rolled-out" in an almost complete state, its massive fin being folded flat to clear the factory roof. Over a dozen partially completed airframes are visible in the background.

At the moment, the B-52A has hit a snag which is delaying delivery of the type to the U.S.A.F. Strategic Air Command. Meanwhile, Boeing's large plant at Wichita, Kansas (where 1,200 B-47s have been built), is tooling-up for "second source" production of the B-52.



The outer wings and tail surfaces are built in vertical jigs (right); the tail-plane leading-edge reaches the roof. In the foreground, spar booms are being drilled. At the foot of the opposite page are seen nose sections in two-floor jigs, and, in the smaller photograph, one of the four landing-gear units is shown on a machine jacked-up for retraction tests on the pre-flight line.

Bay 4 of Seattle's Plant 2 is now the end of the main assembly line for B-52As; on the left are shown the first two production machines nearing completion last autumn. The photograph below was taken much more recently and depicts the pre-flight line stretching the whole length of the West side of the airfield. At night, 31 kilowatts of electric power light up the B-52s for round-the-clock work.

HIGH-SPEED PHOTOGRAPHY

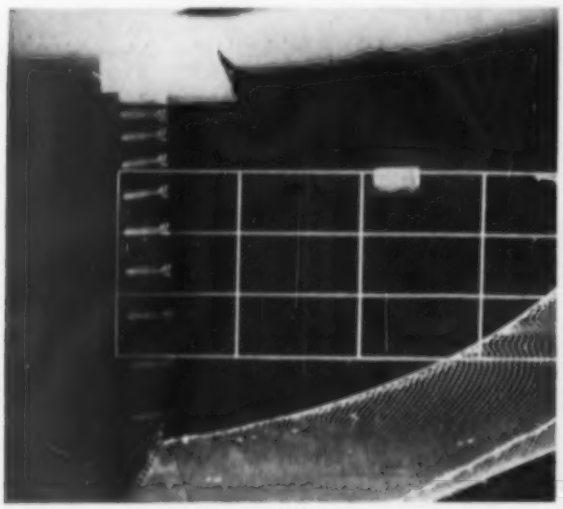
—in the Laboratory and in the Air

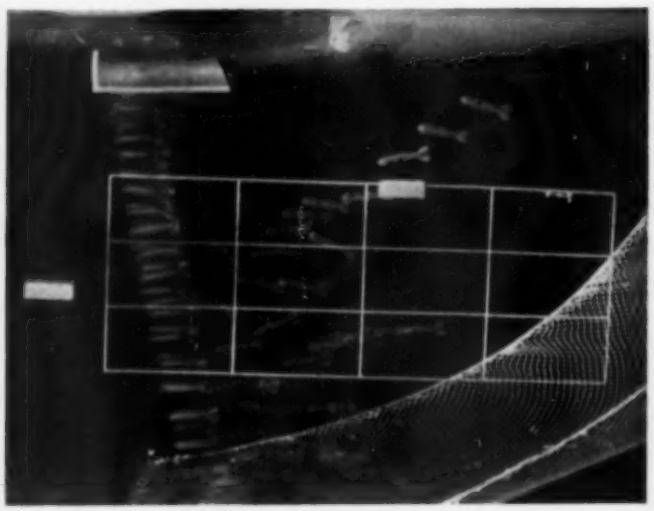
PHOTOGRAPHY, indoor and outdoor, is the subject of two recent items reaching us from America. The first concerns research work by the Boeing wind-tunnel engineering group and the company's engineering photo unit, who have combined in evolving a technique for studying the aerodynamic behaviour of bombs dropped from B-47s.

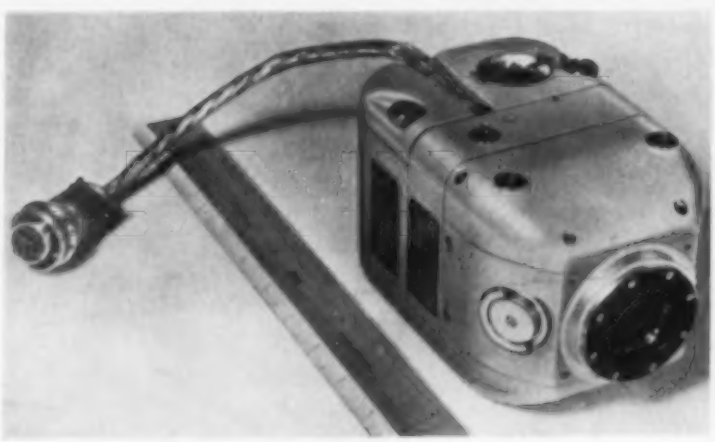
As is generally recognized, a projectile must follow a calculated trajectory if aiming is to be accurate; and this calculation is usually based on a clean fall-away of the bomb from the aircraft. If, owing to aerodynamic effects, or to other causes, the bomb should become unstable, accuracy will suffer.

These phenomena have long been studied photographically, both at full scale and in wind tunnels, the usual method of recording being by ciné cameras. The Boeing departments mentioned above are using a device which registers on a single negative the fall of a scaled-down bomb dropped from a wind-tunnel model aircraft. A revolving disc having six radial slots in its periphery is mounted in front of the lens of a standard camera. Rotated by a motor at a precise speed, the disc permits a series of sharp exposures of about 1/3,000th sec each. Among advantages claimed for the method, as opposed to the more usual stroboscopic light-flash technique, is that steady illumination enables a ciné record to be made at the same time. The two photographs in the centre of this page give an idea of the effectiveness of the technique.

(Above) The interrupter disc fitted in front of the lens of the Boeing camera. (Below) Two records made by the camera, showing on the left the fall of a single model bomb and on the right a salvo. In the latter picture a number of bombs are bouncing upwards from the net and being carried to the rear in the airstream.

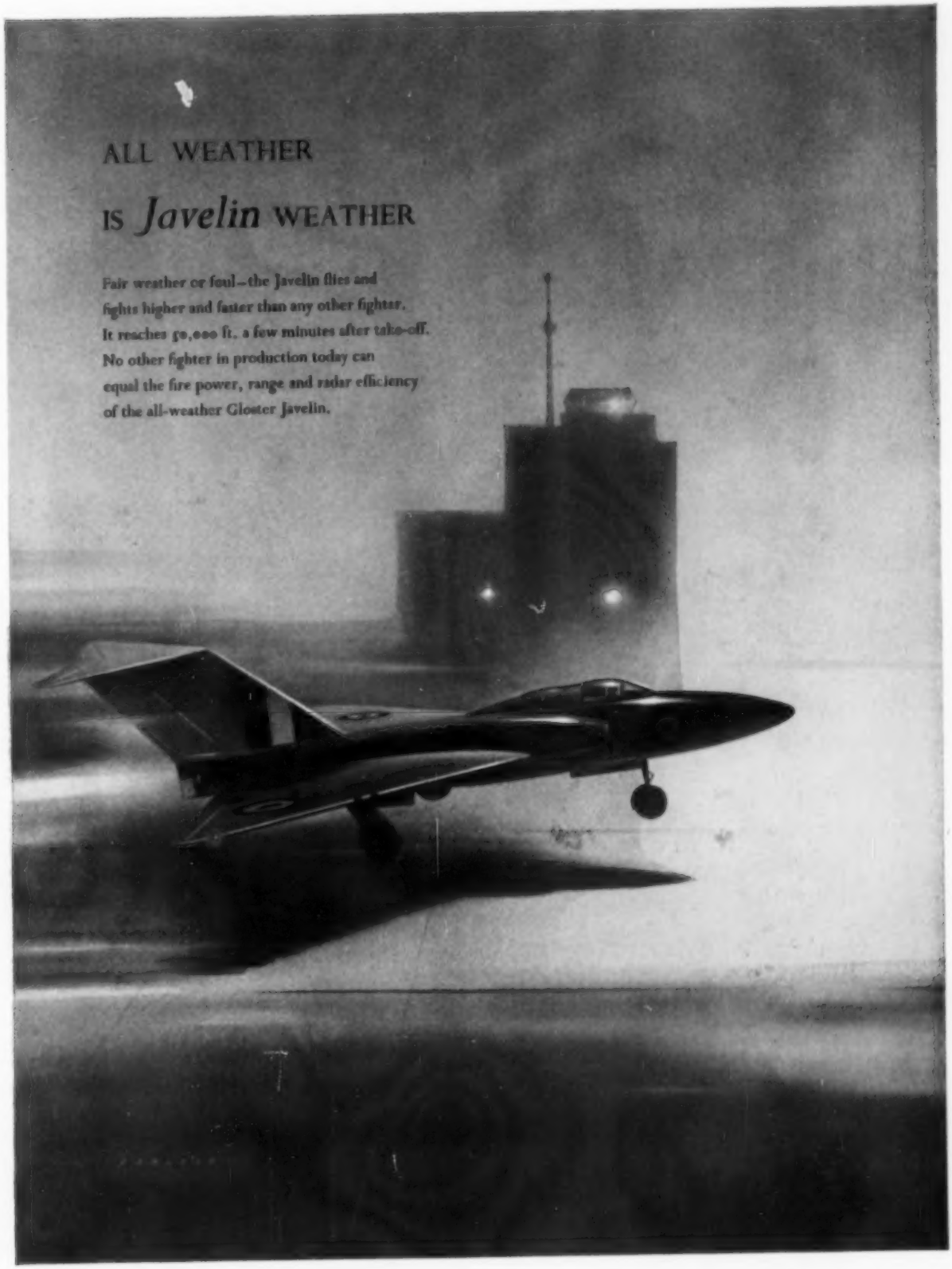






(Left) The new lightweight 70 mm aerial camera developed by the Air Research and Development Command of the United States Air Force.

The second photographic item concerns a new light-weight 70 mm aerial camera designed by Air Research and Development Command for recording low-level rocket and bomb strikes by high-speed aircraft. Designated the P-2, the camera can make six exposures per second at shutter speeds as high as 1/2,000 sec. It can also be used as a combat camera. Two film magazines are available; one, containing 15ft of film, will provide 75 pictures over a period of 12½ sec, while the other will give 239 over about 39 sec.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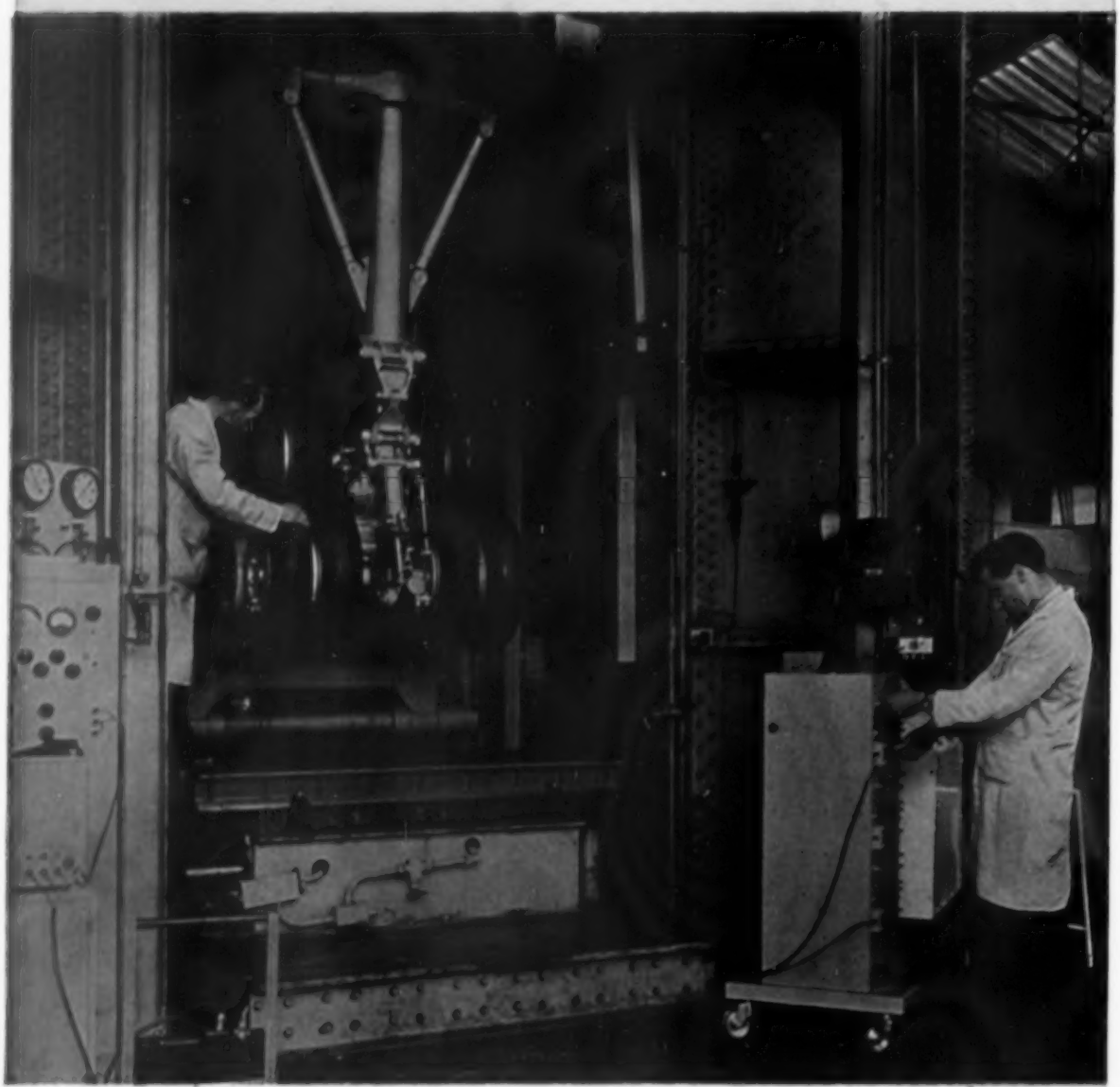


Colour Photograph by The Times "REVIEW OF INDUSTRY"

ELECTRO-HYDRAULICS LIMITED WARRINGTON

CIVIL AVIATION

MORE HERALDS ORDERED

A SECOND "off-the-drawing-board" order for Handley Page Heralds has been placed by an Australian airline operator. Late last year Handley Page announced an order from Queensland Airlines for an undisclosed number; the second company to choose the aircraft as a DC-3 replacement is Australian National Airways, who have ordered "a large fleet".

Neither operator wishes to disclose the number of aircraft involved, but it is understood that the value of the two orders runs to several million pounds.

The fact that overseas orders have been placed at this early stage suggests a promising future for the Herald, which will be a four-engined, pressurized, high-wing transport of 34,000 lb all-up weight. Powered by four Alvis Leonides Major piston engines, it will carry up to 44 passengers or over four and three-quarter tons of freight or combinations of both at cruising speeds of more than 200 m.p.h.

Two prototype Heralds are under construction, the first of which is due to fly this summer. Design of the Herald was based on the findings of a survey of airline requirements throughout the world. This has been followed up by sales tours, such as that now being made in South America by G/C. R. C. M. Collard, Handley Page's sales manager.

AFT-FACING SEATS FOR AUSTRALIA

REARWARD-FACING seats will be mandatory in all new types of civil airliners imported to Australia after January 1st, 1957. This requirement was announced recently by Australia's Director-General of Civil Aviation, Air Marshal Sir Richard Williams, who said that the relevant Air Navigation Order issued by his department also required that all seats in airliners (engaged in regular public transport service) in which major seating modifications were made after January 1st, 1957, should face the rear of the aircraft.

Sir Richard recalled that, for some time past, design requirements for public transport aircraft manufactured in Australia had included rear-facing seats; however, no such aircraft had been produced in the Commonwealth since the order became compulsory.

"Australia's domestic airlines," Sir Richard added, "have a fine record of passenger safety. More than 5½ million passengers have flown on scheduled commercial flights in the last 3½ years without a fatality. Despite this impressive record the Department of Civil Aviation is continuously seeking ways to make flying even safer, and rear-facing seats will contribute notably to the improvement of this high safety standard.

"A close study of accidents involving civil airliners and military aircraft in many parts of the world has shown that rear-facing seats give passengers substantially greater protection. They have been adopted by the Royal Air Force Transport Command since the war, and R.A.F. experts have established from experience over a number of years that passenger protection is increased threefold."

SEVEN SEAS FOR SABENA

LAST week Sabena announced the signing of a contract for six Douglas DC-7Cs for their services between Brussels and New York, and Brussels and the Belgian Congo. The agreement was concluded by Mr. Gilbert Perrier, chairman of the Sabena board, and the first delivery is due in the fourth quarter of next year. The machines will have 62-passenger *de luxe* interiors.

It will be recalled that Sabena were the first European airline to operate DC-4s and DC-6s. Sabena's order brings the total orders for the DC-7 series to 139.

DECCA AND TACAN

COMMENTING on the U.S. Government's reported decision to abandon V.O.R./D.M.E. as a short-range navigation system (*Flight*, February 18th), the Decca Navigator Co. recall that "time and again" the adoption of Decca, or even a tentative trial, has been blocked on the grounds that V.O.R./D.M.E. would become the standard system. The latter is apparently to be replaced by TACAN, a navigational aid providing bearing and distance information on a much higher frequency that V.O.R.

The Decca statement questions the suitability of the new system as an international aid, for the following reasons: "As with V.O.R., it needs a great number of ground stations for effective area coverage; its high-frequency transmissions cannot cover aircraft at low altitudes, where accurate and uninterrupted fixing is essential for effective traffic control; the well-established advantages of pictorial display of position are much harder to realize in practice than with a C.W. system; and the TACAN service would be denied absolutely to helicopters."

It points out that the Decca navigator system is not only free from these disadvantages but that it serves both surface and air transport.

The statement continues: "It would be absurd to pretend that the Decca system is perfect or without shortcomings. It would be even more absurd, however, to compare the money spent on the development of Decca with the vast sums expended [a figure of $130 m is mentioned], apparently to no purpose, on V.O.R./D.M.E. . . . With even a fraction of the support that the ill-fated American system received, the proven attributes of the Decca navigator could rapidly make it the universal aid . . ."

H.D.31 TROPICAL TRIALS

THE Hurel Dubois H.D.31, prototype of the H.D.32 transport, has just completed a tour of North and Central Africa designed to constitute rigorous tropical trials. The H.D.31 now has a certificate of airworthiness for an a.u.w. of 30,000 lb.

The journey was planned to a schedule designed to simulate as far as possible an actual airline timetable, while also ensuring encounters with the worst possible conditions of icing, torrential rain and turbulence. The schedule called for a total of 95 hours' flying, with stages varying between four and nine hours' duration.

Special equipment fitted for the trials included extra fuel tanks to bring the range up to 1,900 miles, a series of acceleration-sensers, a g-counter, film recorders and such navigational equipment as was required for flight in Africa. The pilot was Cmdt. Ponthus, of the Centre d'Essais en Vol, who had carried out the government certification trials. Also on board were a radio operator, engineer and two mechanics and, on the outward and return journeys to Africa, M. Hurel himself. During the tour several Air France pilots took the aircraft over sectors in which they normally flew the airline's scheduled services.

Tests went according to plan and no technical difficulties arose. Maintenance proved simple. Some very severe weather indeed was encountered, including heavy turbulence, icing and torrential rain—in which, at one time, the captain reported that he had been unable to see the aircraft's wings from the cockpit. The take-off from Pointe Noire for Brazzaville was made in weather so bad that the airport commandant refused permission until he signed a document absolving himself from all responsibility. Other aircraft were grounded. On arrival at Brazzaville it was raining so heavily that the crew was unable to leave the aircraft after landing, and the reception committee could not reach them. The H.D.31 (unlike the H.D.32) carries no de-icing gear.

At every point visited, it is reported, lively interest was shown in the aircraft. Air France has 24 H.D.32s on order for services in these regions.

AMERICAN'S REDUCED PROFIT

NET earnings of $11,431,000 (£4m) are reported by American Airlines for the year 1954. The company's net earnings for 1953 were some $2m higher, last year's results being adversely affected by the pilots' strike in August 1954, which resulted in a 24-day suspension of services. An impression of the scale of American Airlines' operations is given by the fact that the company lost almost £1m during that month. During 1954 the airline decided to depreciate their DC-6Bs over a period of seven years instead of five. This decision resulted in a $904,000 (£320,000) contribution to net earnings for 1954.

THE A.O.A. DINES

THE annual dinner of the Aerodrome Owners' Association, held in London on February 24th, marked the end of the 21st year of the Association's existence. On this occasion the guests included A. V-M. the Earl of Bandon, A. V-M. W. J. Seward, Mr. J. D. Profumo, Mr. Whitney Straight, W/C R. A. C. Brie, together with a number of M.P.s and representatives of the M.T.C.A. and the Air League of the British Empire.

The toast of the Association, proposed by Mr. Whitney Straight, was replied to by Councillor L. W. Biggs, of Manchester, the new chairman of the Association, and reply for the guests was made by Air Chief Marshal Sir George Pirie, Chairman of the Air League.

In replying to the toast of Civil Aviation, Mr. Profumo, Parliamentary Secretary to the M.T.C.A., stated that the Ministry was always prepared to listen sympathetically to any appeal for help made by the A.O.A. He reminded them that, in their principal future activity of providing for municipal helicopter stations, they should take care not to start any construction before the requirements for such installations had been finally formulated. These requirements, he said, were being steadily compiled by the Ministry. The introduction of helicopters into large scale inter-city service, though obviously needed in England, would not, he thought, be implemented for some time.

Use of air freight enabled two 34 cwt fine-boring machines to be delivered to Rotol, Ltd., in two days instead of the usual 21. Of German manufacture, the equipment was flown from Stuttgart to London by Sabena; two similar machines, for another firm, brought the DC-4's payload to nearly 7 tons.

CIVIL AVIATION . . .

CATHAY PACIFIC PILOTS HONOURED

THE Queen has approved the award of the Queen's Commendation for Valuable Service in the Air to Capt. Philip Blown and 1st/Off. C. W. Carlton, crew-members of the Cathay Pacific Airways DC-4 which, on July 23rd, 1954, was flying on the normal route from Bangkok to Hong Kong when it was attacked without warning and forced down in a rough sea by fighter aircraft of the Chinese Communist air force near Hainan Island. The citation recalls that one of the starboard engines and the fuel tanks of the DC-4 were set on fire by the first attack. Capt. Blown calmly took all appropriate action to extinguish the engine fire and sent 1st/Off. Carlton to the rear to calm the passengers. Capt. Blown also instigated radio distress calls which were cut short by damage to the set.

Immediately after the first attack Capt. Blown took evasive action but his aircraft was subjected to continuous attacks while diving and at a height of 3,000ft became almost uncontrollable when the rudder and aileron controls were severely damaged. He recalled 1st/Off. Carlton to the cockpit and together they managed to correct the flight of the aircraft, mainly by judicious use of engine power, to enable Capt. Blown to carry out a successful crash landing on the sea.

Freeing himself from the cockpit of the sinking aircraft Capt. Blown began to gather together the survivors, although injured and suffering from shock. 1st/Off. Carlton, who was also injured, discovered survival equipment while in the water and managed to equip some of the survivors with life jackets. He then found the dinghy, which was inflated, and all survivors were taken on board. All survivors were subsequently picked up by a flying-boat and flown to Hong Kong.

BREVITIES

THE Lockheed Aircraft Corporation have announced that the four additional Super Constellations for which Lufthansa are negotiating will be L.1049Gs equipped with wing-tip fuel tanks. It is also stated officially that Air France, Avianca and L.A.V. have each ordered an additional Super Constellation.

* * *

Formerly with Pan American, Mr. Frederick E. Pearce has been appointed regional Press officer for K.L.M., with effect from February 4th.

* * *

B.E.A. have taken delivery of one of the two D.H. Herons ordered recently for service in Scotland. The aircraft, G-ANXB, was flown from Chester to Renfrew on February 12th.

* * *

Formely district manager for S.A.S. at Hanover, Mr. Bernd Barg arrived in London last week to take up his new appointment as U.K. manager for Lufthansa.

* * *

Mr. Evert van Beek has been appointed president of the Avio-Diepen Trading Co., Ypenburg. He succeeds Mr. G. C. Snyders whose resignation at his own request, effective from January 1st, was announced recently.

* * *

Capt. Stanley Williamson, a former R.A.F. pilot who won the D.F.M. with Coastal Command during the war, has been appointed chief pilot of Aer Lingus. In his new post he will remain a fully qualified line captain.

* * *

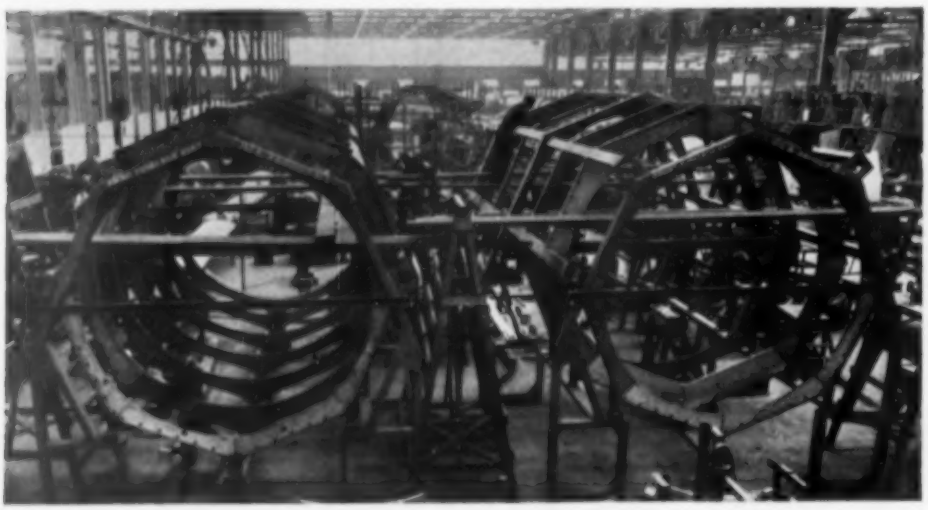
Australian National Airways have taken delivery of the first of two DC-6Bs ordered from the Douglas Aircraft Co. The airline is already operating two DC-6s purchased a year ago from National Airlines.

* * *

Pakistan International Airlines opened a new service between Karachi and Delhi on February 19th. The service is operated three times weekly with DC-3s. It is reported from Pakistan, incidentally, that the amalgamation of P.I.A. and Orient Airways, the domestic carrier, has not yet been completed.

* * *

As a result of the increase in capacity obtained from their new Viscount fleet, Aer Lingus have decided to dispose of their four Bristol 170s. W. S. Shackleton, Ltd., have been given the sole selling rights for these aircraft, which are Mk. 31Es suitable for both freight and passenger work.



Britannia fuselage assembly jigs have already been set up in Short and Harland's Belfast works, where—as announced recently—eight long-range versions of the Mk. 250 passenger-freighter are to be built. Three will go to independents for trooping; the remaining five are being put in hand in anticipation of demand.

A recent arrival from Australia was Mr. C. O. Turner, general manager of Qantas Empire Airways (right), seen here with Mr. Keith Granville, sales manager of B.O.A.C. Their respective companies operate the London-Sydney "Kangaroo" route in partnership.

An application to fly non-stop between New York and Nassau has been filed with the C.A.B. by Pan American World Airways. The American airline says that approval of the application would enable it to compete effectively with B.O.A.C., at present the only company providing direct services.

* * *

In preparation for the delivery of Viscounts during the coming financial year, British West Indian Airways will intensify their sales campaign in North America; the airline hopes to attract an increased share of tourist travel to the Caribbean. The campaign was discussed at Nassau last week at a conference attended by senior officials of both B.W.I.A and B.O.A.C., including Sir Miles Thomas, who has been making a tour of stations in the Caribbean.

* * *

According to French newspaper reports the compensation offered by de Havilland to U.A.T. and Air France for the losses incurred with their Comet 1s amounts to half the initial cost of the aircraft. This would be paid not as cash but in the form of credit towards the cost of new Comets. French newspapers say that this would represent less than a quarter of the total amount lost by the two companies—estimated at some £6m.

* * *

With the object of improving R/T communications on North Atlantic routes an experimental station has been set up by M.T.C.A. at Mangersta, Isle of Lewis, Outer Hebrides. The Station will carry out trials of "ground wave" propagation on high frequency R/T and of directional aerial arrays for V.H.F. R/T. Details of the H.F. transmissions are given in *Information Circular* No. 23/1955, and the V.H.F. trials will be described in a later circular.

* * *

In reply to a parliamentary question last week, the Minister of Transport and Civil Aviation said that work on the second runway at Prestwick should be completed in the spring of 1956. Limited use of the runway, without its associated taxi-track, should begin in the autumn of this year. A new control tower would be ready by 1956, and p'ans were being prepared for a new terminal building which would become necessary "in the course of the next few years."

CLUB AND GLIDING NEWS

AFTER a period of seven years without any accommodation for its members, The Scottish Flying Club recently received permission from the M.T.C.A. to rent a building on Renfrew Airport for use as a clubhouse. This important occasion was celebrated on January 22nd with a cocktail party, at which some 100 members were present.

The building now occupied was the Club's pre-war sleeping quarters, and a number of the bedrooms have been retained. The lounge, although small, has been tastefully decorated under the supervision of Mr. F. A. W. Mickel, the Chairman, and a limited amount of catering can be provided.

It is hoped that the Club will regain its pre-war popularity now that it is able to offer members a comfortable meeting place. The facilities offered are adequate for the present, but not on such a lavish scale as before the war, when the S.F.C. occupied its own premises. The committee are a little more confident of the future and look forward to an improvement in the financial position, as a great deal of money has been lost during the past seven years.

An encouraging fact is that flying hours are increasing. During 1954 just under 1,000 hours were completed; were it not for the bad weather and shortage of aircraft this figure would have been much higher. Thirteen Private Pilot's Licences were gained.

MEMBERS of the Liverpool Flying Club succeeded in flying 67 hours during December and 65 in January, despite very bad weather over Merseyside during these months. Three pupils made their first solos during the same period, in addition to one first night solo. The club fleet now consists of one Gemini, three Austers and one Taylorcraft. One of the Austers is equipped for night flying which, the club reports, members find extremely good value at only £3 10s per hour as against £3 per hour for day flying.

The social side of club activities has been taken over entirely by the members through their committee and, since this arrangement came into force, three very pleasant dances have taken place.

AT the annual meeting of the Northamptonshire Aero Club, held in the clubhouse on February 18th, Alderman C. M. Newton, M.B.E. (chairman), said in his review of the year that there had been an increase in both membership and flying hours, despite the rather unkind flying weather. He felt that the main credit lay with the club's flying instructor, who had worked hard in coaching the many new young members. Of these, 46 had been given instruction and 44 had flown solo. Sixteen Private Pilot's Licences had been obtained. The A.T.C. Flying Scholarship Scheme had again operated and ten cadets had been chosen for the course. Six had so far achieved their Pilot's Licences.

In the annual flying contests the results were: Best student pilot, C. Boddington; Navigation contest, M. H. Burrill; "Find your way home" contest, A. West; General flying, G. Thomas.

Social events had included a lunch patrol and garden party which were attended by numerous pilots from clubs as far afield as Elstree, Liverpool and Darlington. A flying weekend to the Isle of Wight was very popular, as were the many dances, including the annual tramps' party and punch party.

THE Isle of Wight Gliding Club reports that it is at last operational, just over a year from the first public meeting. One Cadet glider has been overhauled and has a C. of A.; a second machine (minus centre-section fabric) is used for ground-sliding.

On January 30th, T. R. Beasley (secretary) first test-hopped the Cadet and followed this with a number of circuits in order to give the winch-driver some experience. February 13th was the first real training day; after the air test, slides and hops proceeded, mainly for power-pilot members and two ex-A.T.C. members who gained "C" certificates well over a year ago. This proved a very successful day, in which all members learned a lot about ground-handling —and were introduced to the frustrations of gliding.

Modifications are in hand to convert the club's ex-fire engine into a self-propelling winch. The club is fortunate in having the use of Sandown airfield, including hangarage and an excellent clubhouse. Chairman of the new group is Mr. R. Stratton.

SINCE the Avro Gliding Club started operations in May, 1953, members have logged over 2,000 launches and gained 22 "A", 22 "B" and 5 "C" certificates. This has been achieved with one winch, a T.31B and a Tutor.

The club operates from the company's airfield at Woodford in Cheshire. This is a flat site about three miles west of the Derbyshire foothills and, in certain east-wind conditions, soaring is possible in quite good waves. So far, no wave has been experienced this year, but last December one was contacted at 500ft and a rapid climb to 3,400ft was followed by a flight of one hour's duration. These figures still stand as club records.

Last year proved a very difficult one for the club, which was plagued with more than its share of snags in the form of an unwilling winch and retrieving vehicle (a motor-cycle combination) —as well as the weather. In addition, members lost the services of their first chief instructor, Mr. P. G. Sharman (who joined the R.A.F.), and Mr. Peter Rivers, who had also put in a lot of hard work for the club in the early days.

A second winch is now in operation, and a Ferguson tractor is being purchased for retrieving purposes. With this new equipment, members hope to achieve a lot more gliding during 1955.

THE Aero Club of Ireland, founded in May last year, now has 60 members, 20 of whom own their own aircraft. Other news contained in a letter from David Montgomery, the club's secretary, is that an "air pageant and flying display" is planned for Whit Sunday and Whit Monday, May 29th-30th. British and overseas pilots will be invited to take part in "many speed and novel events."

RECENTLY formed, the Southampton Group of the Popular Flying Association is now operating the German Zaunkönig G-ALUA, previously flown by the Experimental Flying Group and, more recently, the Ipswich Group. Main supporters of the new group at Southampton are John Squire (chairman), John Isaacs (hon. secretary), Colin Green and Peter Whatford, all members of the Hampshire Aeroplane Club at Eastleigh Airport.

Art and the Aircraft Designer

GIVING the third R. K. Pierson Memorial Lecture on February 23rd, before a crowded meeting of the Weybridge (Surrey) branch of the Royal Aeronautical Society, Mr. W. E. W. Petter (managing director and chief engineer of Folland Aircraft Ltd.) chose for his subject *Some Thoughts on Creative Design and its Mechanism*. He explained at the outset he did not intend to talk about aircraft design as such but to draw parallels between the art of the aircraft designer and the other arts.

There was an artistic element in aircraft design which was most important and should receive more attention than it did, he said. In its development much could certainly be learned from a study of the creative faculty as a whole, as exemplified by some of the great masters and those who had studied them. Many signs of the artist could be seen in the men who had designed some of the world's best aeroplanes, and could call it either sound engineering or beauty, as one wished.

To illustrate the manner in which famous writers, musicians and painters had sought and found the inspiration which ultimately made them famous he quoted works on Coleridge, Van Gogh, Leonardo da Vinci, Schumann and Bach.

"The artist starts," said Mr. Petter, "with chaos, a mass of impressions—many of them inevitably irrelevant. In assimilating the mass he needed the "falcon's eye" which picked up those impressions likely to be of value, even though in no way associated one with another, and sent them down for storage in the subconscious mind, where they might lie for a lengthy period, or, indeed, for ever.

The true artist was impelled towards a sense of perfection—that is, the result most satisfying to the creator—and no trouble could be spared until this was achieved. Instancing Porsche, the well-known German engineer and designer of the Volkswagen car, he quoted from K. B. Hopfinger's book *Beyond Expectation*: "Every minute Porsche could spare he would spend behind drawing boards. There he would stand and look at a drawing, when all of a sudden he would remark: 'This is no good. I don't like it; there must be a simpler solution.'"

It was, Mr. Petter maintained, an excellent thing to cultivate "a keen sense of dissatisfaction," so that improving changes could be made the moment an opportunity offered. To give point to this assertion he used slides to show changes through which the Westland Lysander's landing gear passed before it reached its final and satisfactory form.

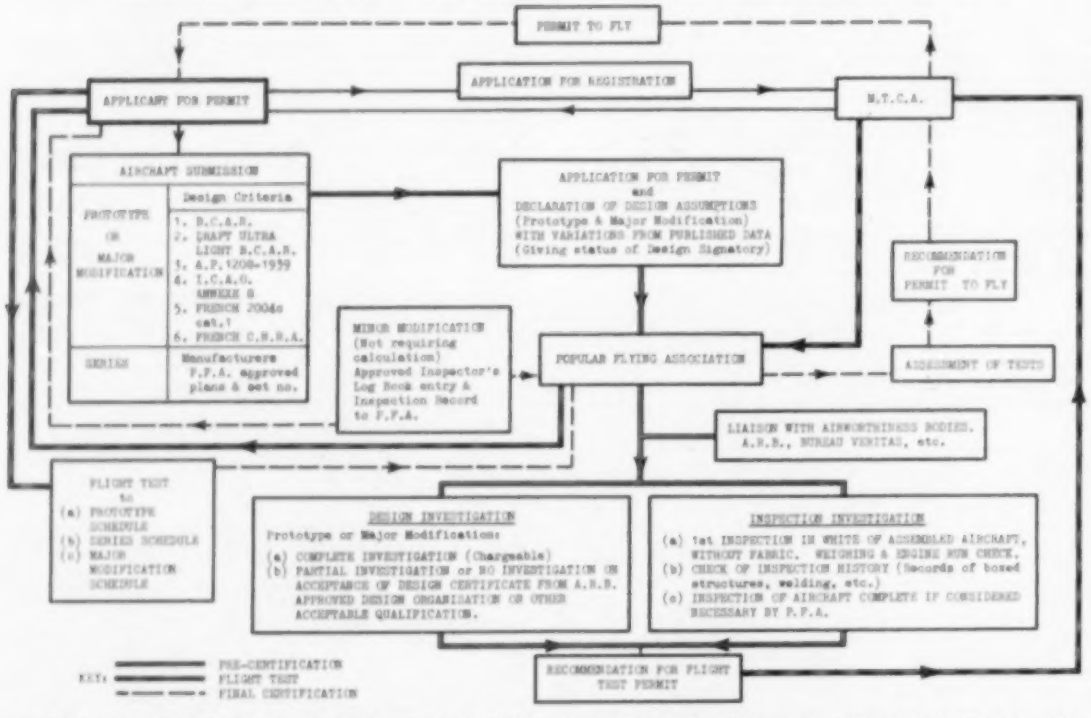
In the development of the "creative" engineer a natural gift was probably essential, the lecturer believed, but it seemed that other favourable factors would include a liberal education (not too specialized); wide reading (well outside the technological sphere); artistic stimuli, such as taking an interest in sculpture, painting and architecture and in other branches of engineering; and everything likely to produce intellectual "jolts," such as travel, and meeting and talking with men of superior ability in similar walks of life but working under different circumstances.

Creators should not be tied too much to the desk or drawing board. Some personal knowledge and experience of practical manufacture, handling of materials, tools, etc., should form part of a complete and balanced background for collecting the impressions for creative work. If he could not get this directly the engineer who aspired to creative achievement should "play around" with cars or radio, or have some other practical hobby. Similarly, while he might not be a pilot, he should talk to pilots and sometimes go up in an aeroplane. Finally, he should have training in a team under a "master" designer—such as R. K. Pierson had been.

The lecturer thought that the best aircraft were still produced by a team which was led by a chief who was able to give most of his time—"waking and sleeping"—to a new aeroplane over a prolonged period; but there was no doubt that, after some years of working together under the right sort of chief, the whole team became so unified and embodied with a common sense of values that it became a willing "loom" which would produce not one but many "tapestries" to different patterns, in all of which would be found the same inspiration.

Mr. Henry Gardner (chief designer, guided weapons, Vickers-Armstrongs Ltd., Weybridge) and Mr. George R. Edwards (managing director, aircraft division, and president of the Weybridge Branch of the R.Ae.S.) both made brief speeches complimenting Mr. Petter on his lecture.

"ULTRA-LIGHT" AIRWORTHINESS PROCEDURE


PERMIT TO FLY
APPLICATION FOR REGISTRATION
APPLICANT FOR PERMIT
N.T.C.A.
AIRCRAFT SUBMISSION
Design Criteria
PROTOTYPE OR MAJOR MODIFICATION
1. B.C.A.R.
2. DRAFT ULTRA LIGHT B.C.A.R.
3. A.P.1208-1939
4. I.C.A.O. ANNEXE G
5. FRENCH 2004e cat.?
6. FRENCH C.N.R.A.
SERIES
Manufacturers P.F.A. approved plans & set no.
APPLICATION FOR PERMIT and DECLARATION OF DESIGN ASSUMPTIONS (Prototype & Major Modification) WITH VARIATIONS FROM PUBLISHED DATA (Giving status of Design Signatory)
RECOMMENDATION FOR PERMIT TO FLY
MINOR MODIFICATION (Not requiring calculation) Approved Inspector's Log Book entry & Inspection Record to P.F.A.
POPULAR FLYING ASSOCIATION
ASSESSMENT OF TESTS
LIAISON WITH AIRWORTHINESS BODIES. A.R.B., BUREAU VERITAS, etc.
FLIGHT TEST to (a) PROTOTYPE SCHEDULE (b) SERIES SCHEDULE (c) MAJOR MODIFICATION SCHEDULE
DESIGN INVESTIGATION
Prototype or Major Modifications:
(a) COMPLETE INVESTIGATION (Chargeable)
(b) PARTIAL INVESTIGATION or NO INVESTIGATION ON ACCEPTANCE OF DESIGN CERTIFICATE FROM A.R.B. APPROVED DESIGN ORGANISATION OR OTHER ACCEPTABLE QUALIFICATION.
INSPECTION INVESTIGATION
(a) 1st INSPECTION IN WHITE OF ASSEMBLED AIRCRAFT, WITHOUT FABRIC. WEIGHING & ENGINE RUN CHECK.
(b) CHECK OF INSPECTION HISTORY (Records of boxed structures, welding, etc.)
(c) INSPECTION OF AIRCRAFT COMPLETE IF CONSIDERED NECESSARY BY P.F.A.
RECOMMENDATION FOR FLIGHT TEST PERMIT
KEY: PRE-CERTIFICATION
FLIGHT TEST
FINAL CERTIFICATION

Now available from the Popular Flying Association are details of the procedure to be adopted in constructing ultra-light aircraft under the "permit-to-fly" scheme, with its modified airworthiness requirements. Broadly, as shown above, the scheme is based on the French airworthiness system for ultra-light aircraft, coupled with proven British civil-aircraft procedures. The full description of the scheme is contained in "Airworthiness Procedure for Ultra-light Aircraft," obtainable from the Association (price 5s 3d) at Londonderry House, Park Lane, London, W.1.

Marconi VHF Airport Direction Finder

TYPE AD200

The type AD200 equipment provides rapid automatic bearings for air traffic control, approach and fixer services.

Two independent channels are provided and, by the use of Voice Frequency tones, full remote control and presentation is available. A normal telephone line will permit remote control up to distances of thirty miles. This may be increased considerably by the inclusion of ordinary telephone repeaters.

Bearings are displayed on meters reading directly in degrees. This system has many advantages and greatly simplifies the provision of additional bearing presentation, as extra meters may be fitted into control desks or supplied in compact table consoles.

Automatic monitoring provides a continuous check of the accuracy and correct functioning of the equipment.

The illustration shows the local equipment console. Both receivers, the aerial mixing unit, modulators and associated oscillators, corresponding to a twin channel equipment are all built into the one cabinet. The bearing indicator meter for monitoring is common to both channels, and can be switched to either. Remote control and display units of similar design are required for each channel. Desk mounted bearing repeater units are available for display at other points.

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The Hawker
HUNTER F.2 *fighter*

The Gloster
JAVELIN *all-weather fighter*

The Handley Page
VICTOR *crescent-wing bomber*

The English Electric
P.1 *fighter*

☆ *The Republic F.84F*
THUNDERSTREAK *fighter*

☆ *The*
MARTIN B 57 *(Canberra) bomber*

☆ *The North American*
FURY *fighter*

☆ *The Douglas A4D*
SKYHAWK *bomber*

☆ *The Grumman F9F-9*
TIGER *fighter*

☆ *The Lockheed*
F-104 *fighter*

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RUSSIA'S Il-14

Developed Version of the Il-12 Pays a Brief Visit to London Airport

A RARE sight indeed at English airports are Russian civil aircraft; and, though descriptions of them occasionally come from inside and just outside the iron curtain, comparatively little is known in detail about them. The mainstay of the Russian airline fleet is, of course, the Il-12, a conventional twin-engined monoplane with tricycle undercarriage, which in performance and date of design is approximately equivalent to the Viking. With the Li-2 (Dakota copy), the Il-12 is in service with a number of iron (and bamboo) curtain countries; and the examples seen in the West, except at Helsinki, have mostly been operated by those countries.

Last week a new variant of the Il-12, officially designated Il-14, arrived at London Airport. It was a Russian Air Force V.I.P. aircraft which, bringing Mr. Gromyko to the London Five-Power conference, had come from Moscow *via* Berlin. On the last stage of the journey it carried two R.A.F. navigators whose duty it was to assist the Russian crew in Western control and navigation procedures. The arrival at London Airport was somewhat complicated by the fact that the Russian crew spoke no English, while the G.C.A. controllers who were trying to talk the aircraft down spoke no Russian. The process of translation, which had to take place in the aircraft, caused a delay in following instructions which led to two over-shoots before a successful landing was accomplished. After each overshoot the aircraft had to return to a holding point and take its place in the queue to land. The difficulty was finally overcome when the Russian Air Attaché, Col. Chizov, went to the control tower to interpret. The visibility, meanwhile, was some 1,400 yd.

As the accompanying *Flight* photographs show, the latest Russian visitor differs in several ways from its predecessor, the Il-12. Principally, the shape of the fin and rudder is completely new, matching what appear to be rather more powerful engines than the 1,650 h.p. ASH 82 FN two-row radials of the Il-12. The Il-14's engines resemble 2,000 h.p. Duplex Cyclones, with some features of the installation reminiscent of Convairliner and Constellation practice. Airscrews are still large-diameter, four-bladed variable-pitch units. The carburettor air intake, with ice-guard, is on top of the cowling, with what would appear to be an alternative hot-air intake inside the cowling near the cylinders. The two exhaust pipes have been led, Convair-wise, rearwards inside an extension of the nacelle, to give thrust-augmentation by exhausting past the trailing edge. The large doors covering all three undercarriage unit bays open only while the units are moving up or down. The nosewheel appears to be non-steerable, with a friction shimmy-damper and a very large "doughnut" tyre. The twin main-wheel tyres are also of this type.

In conformity with Il-12 practice, flush-riveting is used only on wing leading edges and engine nacelles. Ailerons, elevators and rudder are fabric-covered, with metal trim-tabs, and the wing-tips are square-cut. Taxying lights shine through panels in the extreme nose; and the tail light, remarkably enough, is an externally attached lamp whose supply cable runs outside the fuselage skin to the root of the tailplane. The remarkable similarity between the nose contours of the Il-14 (and the Il-12) and the Dakota is noteworthy.

The aircraft was finished in lime-green with a severely simple cheat-line motif running back from the nose. The serial number was 4340203, with the identification number 012 in red on the rudder. (An identical machine, no. 4340301 with identification 005, recently visited Paris.) The traditional Red Air Force star was gaily picked out in dark and pale segments with a black border outline. The "jagged" fin-top motif did not cover any recessed aerials. There were, however, two long wire aerials between crew compartment and fin and tailplane, suitable for M.F. equipment, two stick aerials, possibly for V.H.F., a short wire aerial beneath the forward fuselage, and a "ram's horns" aerial suitable for I.L.S. or some form of V.H.F./D.F. navigation or approach aid. Under each tailplane there was a T-shaped aerial which might serve a radio altimeter. The "ram's horns" aerial was, of course, a feature of the American B-29.

The window arrangement of this V.I.P. aircraft indicates that the first two rows of seats of the standard civil version have been eliminated in favour of a freight compartment with an access hatch on the port side close to the wing leading edge. The passenger access door is, in conformity with standard Russian practice, to starboard. The structure of this door, and the presence of a number of air-extractor outlets in the cabin roof, indicate that, like the Il-12, this aircraft is unpressurized.

"Flight" photographs

The views of the Il-14 on this page can be compared with that of the Il-12, above, in Czech markings. Principal differences are in the engine nacelles, fin and rudder and wing-tips. The view at lower right was taken as the Russian crew arrived to fly the Il-14 away to Paris.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

Royal Visitor at Biggin Hill

ON Tuesday last week the Shah of Persia visited R.A.F. Station Biggin Hill. After being received by Marshal of the Royal Air Force Sir William Dickson, Chief of the Air Staff, and Mr. George Ward, Under-Secretary of State for Air, the Shah inspected a guard of honour and saw the Queen's Colour paraded. He then inspected the cockpits of a Hunter, a Canberra, a Meteor and a Vampire Trainer. The flying display, which was to have included a fly-past by the Hunter 2s of No. 257 Sqn., specially detached from Wattisham, was curtailed by extremely bad weather. S/L. I. G. Topp gave a spectacular display of tight, low-level turns in a Canberra, the Hunters took off for their home base and finally the Shah watched in the G.C.A. caravan while several pairs of Meteors were talked down to a landing. He is himself an experienced pilot.

Sir Clifford Sanderson Retires

THE retirement is announced of Air Marshal Sir A. Clifford Sanderson, K.B.E., C.B., D.F.C., who from 1952 until last November was C-in-C. F.E.A.F.

Sir Clifford served in both wars. In February 1945, as an air commodore, he was seriously injured in an accident to an aircraft carrying a number of Sir Winston Churchill's staff. From 1948 to 1949 he was A.O.C. Air H.Q. Malaya and later became Director General (1) at the Air Ministry.

Future of the R.Aux.A.F.

SPEAKING at the annual dinner of No. 612 (City of Aberdeen) Squadron, R.Aux.A.F., Air Marshal Sir Dermot A. Boyle, C-in-C. Fighter Command, referred to the future of the Auxiliary squadrons. He said that the advent of nuclear weapons made the first three days the most vital if war should break out; that fact had to be reconciled with a desire to keep on the Auxiliaries, with their wonderful spirit. Those in authority had a two-fold responsibility—to see that the taxpayers' money was well spent and to see that the tremendous amount of voluntary effort put in by the Auxiliaries was not in vain. [News of plans for the R.Aux.A.F., given in the Air Estimates Memorandum, appears on p. 260.]

Sir Dermot went on to say that he thought it unwise to try to look too far into the future; but, he told the squadron, "You won't be going out of business. Nothing will happen to you for at least three years." He also broke the news that they would not be going abroad for summer camp this year. The camp, spent in Malta last year, will be held in the south of England, probably in Devon or Sussex.

Other speakers at the dinner were A. Cdre. Finlay Crerar, the first C.O. of the Squadron when it was formed in June 1937; A. Cdre. Sir Ian A. Forbes-Leith; S/L. N. H. McLean, C.O. of the Squadron, and F/L. F. D. Mainland. S/L. McLean is relinquishing his command next month and occasion was taken to present him with a mounted model of a Vampire, the aircraft with which the squadron was equipped during his command. The model was handed over by Sir Ian Forbes-Leith.

R.C.A.F. Neptunes

DELIVERY of the Lockheed Neptunes for the Royal Canadian Air Force is expected to begin this month.

The first few will be handed over at Lockheed's factory at Burbank, California, where Canadian crews will complete their operation, servicing and maintenance training on them.

The Neptunes will be flown to their new home at Greenwood, N.S., where at some future date they will be joined by the maritime reconnaissance Britannias, now being developed.

D-Day Commemoration Plaque

SPONSORED by members of the Parachute and Glider Pilot Regiments and No. 38 Group R.A.F. Old Comrades Associations, a plaque is being erected at Harwell. It is to commemorate the departure, from that point—originally an R.A.F. airfield—of the first R.A.F. aircraft of No. 38 Group (Airborne Forces), carrying troops of the 6th Airborne Division for the D-Day landings. The memorial will be unveiled by General Sir Richard Gale, G.C.B., K.B.E., D.S.O., M.C., on May 14th.

The cost of the plaque is being met from private donations, and contributions should be sent to the Honorary Secretary, Harwell Commemoration Plaque, 54, Lombard Street, London, E.C.3.

Canberras for Canadian Exercises

EIGHT Royal Air Force Canberras will fly to Canada this summer to take part in Canadian exercises. They will be based at Goose Bay and from there will operate as "enemy" bombers.

During the latter part of their visit the Canberras will visit Ottawa and Montreal and make a tour of the R.C.A.F. training bases in western Canada.

Cranwell Reunion in Singapore

AT the sixth annual reunion of old Cranwellians in Singapore no fewer than 32 former cadets were present, including A.V-M. W. J. M. Akerman, who entered the college in 1921, the year it was founded.

The guest of honour was A.V-M. F. R. W. Scherger, R.A.A.F., and among those present were Air Marshal F. J. Fressanges, C-in-C. F.E.A.F., who presided, A.V-M. A. D. Gillmore, A.V-M. W. H. Kyle, A. Cdre R. C. Field and A. Cdre. Moore.

"Lore of the R.A.F."

A MEMBER of the Military Historical Society, Mr. B. N. F. Bright, is engaged on writing a book to be published under the title of *The Lore of the Royal Air Force*. It will deal with Service customs, traditions and practices, and uniforms and badges.

Anyone who can assist the author with suitable material is asked to get in touch with him at 92 Brook Lane, Newton, Chester.

R.Aux.A.F. Appointments

THE appointment has been made of W/C. D. F. Perrens, D.S.O., D.F.C., R.Aux.A.F., to command No. 3618 (County of Sussex) Fighter Control Unit, and W/C. E. L. T. Barton, O.B.E., R.Aux.A.F., to command No. 3700 (County of London) Radar Reporting Unit.

W/C. Perrens spent most of his war service doing tactical reconnaissance work with the Desert Air Force, being awarded the D.F.C. in 1944 and the D.S.O. a year later. He joined the R.Aux.A.F. in 1948 and has been with No. 3618 F.C.U. since its formation.

W/C. Barton is a specialized radar and signals officer. He was mentioned in Despatches in 1945 and awarded the O.B.E. in June 1946.

Reunions

THE eighth annual reunion of No. 2 Group Officers' Association will be held on May 7th at the Park Lane Hotel, London. The reunion covers all the wings, squadrons and units, and a special welcome is extended to W.A.A.F. officers. Particulars from S/L. J. A. Beattie, 55, Shirley Street, Hove 3, Sussex.

An all-ranks reunion of present and past members of No. 21 Squadron is to be held at the Albert Tavern, 52, Victoria Street, London, S.W.1, at 1900 hr on May 21st. Lounge suits will be worn. Further particulars and tickets (8s 6d) from Mr. J. G. B. Draper, Cross Leys, South Stoke, Reading, Berkshire.

A feature of H.M.S. "Ark Royal" is the deck-edge aircraft lift, the first of its kind to be installed in a British carrier. This additional lift and the two centre-well lifts were installed by the Fraser and Chalmers Engineering works of G.E.C. Ltd.

(Top left) H.M.S. "Ark Royal" alongside in Cammell Laird's dockyard at Birkenhead. (Top right) A multiplicity of radar and radio aerials crowns the island. (Bottom left) Lt-Cdr. R. W. Kearsley (Lieutenant-Commander Flying), Cdr. M. F. Fell, D.S.O., D.S.C. and Bar (Commander Air), Capt. D. R. F. Cambell, D.S.C. (Commanding Officer) and Lt-Cdr. G. R. Woolston (Lieutenant-Commander Operations). (Bottom right) The angled deck and rear lift as seen from the flying control platform on the bridge.

"ARK ROYAL" COMMISSIONED

THE fourth ship to be called *Ark Royal*, and the second carrier of the line, was commissioned on Wednesday last week. She is the largest carrier in the Royal Navy, with a length of over 800 ft, some four feet longer than her sister ship *Eagle*, which joined the fleet in 1952.

Ark Royal has an angled deck, two steam catapults and the mirror landing-aid, and is the first carrier to be so completely equipped. Provision is made for remote control of the engines if radio-active air is likely to be drawn into the engine rooms. Crew accommodation is also revised and special messing facilities have been provided. Her peacetime complement of men and aircraft is to be respectively 2,200 and 50.

The carrier has taken 11 years to build, this period including a number of delays while modifications were incorporated to keep the design in line with the latest requirements. She is reported to have cost over £20 million. After commissioning she was due to start her acceptance trials last Friday.

At a ceremony to be held at Portsmouth on March 26th a ship's bell, subscribed for by the ship's company of the third *Ark Royal* is to be handed to the company of the present carrier. The bell, which is of silver and weighs nearly two hundredweight, will be received by Capt. D. R. F. Campbell, D.S.C., R.N. It was cast by Gillett and Johnson of Croydon in 1943 and has since hung in the wardroom at Lee-on-Solent.

The ratings who served in the third *Ark Royal* are invited to attend the ceremony at Portsmouth, which will take place at 11.30hr, and will be followed by a tour of the ship and lunch. Applications for tickets, which should indicate the period served in the ship and the rating held at the time, should be adressed to the office of the Flag Officer Air (Home), Wykeham Hall, Lee-on-Solent, Hants.

The inscription on the bell consists of the ship's crest, the names of the commanding officers from November, 1938, to November, 1941, and a brief summary of the principal operations on which the ship was engaged during this period, together with the words: "From the company who sailed in the *Ark* in the years 1939-1941 to those who followed them."

Accompanying the bell is a framed notice on vellum which reads: "This Bell was cast at the behest of the Company of the third *Ark Royal* in memory of a great commission. They bequeath the Bell to all who sail in the ships that bear her name, in the belief that the bond of fellowship and the spirit of enthusiasm which inspired them will live on in the *Ark Royals* that are to come. May the sound of this Bell remind us of the power of harmony in the lives of men."

The bell will hang in an oak belfry copied from designs in the National Maritime Museum and constructed by Cammell Laird, who built the third and fourth *Ark Royals*. This belfry, the cost of which has been met by officers who sailed in the third *Ark Royal*, will be handed over by Admiral of the Fleet Sir Arthur Power, G.C.B., G.B.E., C.V.O., Commanding Officer of H.M.S. *Ark Royal* from November, 1938, to April, 1940. In addition, a specially bound book recording the histories of all the *Arks* has been prepared.

THE INDUSTRY

Glass Fibre Laminates

IN a recent note on developments in glass-reinforced plastics for the aircraft industry we mentioned that there had recently been moves in the direction of further improvement of the fire-retardant qualities of these materials and that grades suitable for use in aircraft interiors were now available.

Among examples of this class of plastics are the "Rilglaze" glass fibre polyester resin laminates manufactured by Rubber Improvement, Ltd., Wellingborough, Northants. Available in various grades, these laminates are, in general, characterized by their high mechanical strength and heat-resistance value, combined with insulation properties. Special fire-retardant grades for the aircraft industry are suitable for such uses as cabin-wall trim, luggage and compartment linings.

Another grade, with good punching and machining properties, is commonly used in the form of blanks for the manufacture of electrical components.

Ground Radio at L.A.P.

IN a summary of the uses to which their telecommunications equipment is now being put at London Airport, the firm of Pye, Ltd., mention that the largest user is Shell-Mex and B.P., whose tankers daily supply some 50,000 gallons of fuel to aircraft there. At one time, when an aircraft was waiting to be refuelled on tarmac two or three miles from the company's main depot, a tanker would be despatched, perform the necessary duty and then return to base—only to find five minutes later that a refuelling call had come from an aircraft parked a few yards from the first machine. The obvious solution was to use radio, and the fuel company's manager at the airport, Mr. J. R. Grant, forthwith equipped 18 of his biggest tankers with Pye "Reporter" radio-telephone sets; the number is now being increased to 25.

B.E.A. also make extensive use of the Pye "Reporter," particularly on tractors which, towing aircraft across from the maintenance base, have to cross runways and taxi tracks, with a consequent need for very clear and up-to-the-second instructions to drivers if safety is to be maintained. Many other varieties of orders, of course, are also passed to tractor drivers.

On the tarmac, a familiar sight is the traffic officer with a Pye Walkie-Talkie, by which a steady flow of two-way information is maintained between the B.E.A. traffic offices and aircraft loading or unloading.

B.O.A.C. also use "Reporter" equipment on tractors; and, instead of using Walkie-Talkie, they have two "Reporter" sets fitted into two sets of passenger steps. Their duty officer also has a car fitted with R/T equipment. Trans-World Airlines are another company using "Reporter" sets.

Pye, too, are identified with air-to-ground equipment at London Airport. They are, for instance, co-operating with Pan American in the installation of an experimental V.H.F. control system. Also, in co-operation with other electronic-equipment manufacturers they have played a part in the installation of the I.L.S. system at the airport; they were responsible for all the ground equipment for this system.

P.T.F.E. Developments

STATED to be one of the earliest concerns to develop the processing of P.T.F.E. (polytetrafluoroethylene), the firm of Crane Packing, Ltd., of Slough, announce the design and construction in their own works of new extrusion plant for this material. Now in continuous operation, the plant makes practicable the extrusion of P.T.F.E. rod and tube in external diameters of up to 4in. Tube of this diameter has a minimum wall-thickness of ¼in and is being supplied in standard lengths of three feet, though other lengths can be supplied to special order if the quantity required justifies it. Two grades are supplied in rod and tube form—one the standard grade and the other a special grade possessing exceptionally good electrical properties.

Also announced by Crane Packing, Ltd., is a new process which they have developed for applying P.T.F.E. dispersion coatings; they are now in a position to undertake the application of such coatings to moderately large components.

About Fuel and Fuelling

ISSUED primarily as a manual for Esso airport personnel, the *Esso Aviation Refuelling Guide* has been translated into seven different languages and circulated to airfields throughout the world. The current edition, a booklet of 70 pages, is a model publication of its kind; attractively printed in three colours and illustrated with numerous diagrams and thumbnail humorous sketches, it explains in simple, forceful language every aspect of the duties likely to be performed by its readers. Needless to say, the theme of safety is prominent throughout.

Another booklet published by the Esso Petroleum Co., Ltd. (Aviation Department, Artillery House, Artillery Row, London, S.W.1) is a table of equivalents for Esso Aviation products, consisting of classified lists of British and American fuel, oil and lubricant specifications. Indicative of the scope of the company's business is the fact that some 110 products and/or grades are listed.

IN BRIEF

I.V. Pressure Controllers, Ltd., have concentrated their sales organization at Atlas House, 683 London Road, Isleworth, Middlesex. Their factories are at Forge Works, 844 Bath Road, Cranford, Middx., and Southern Trading Estate, Drakes Meadow, Gresham Road, Staines, Middx.

* * *

A leaflet, No. BH31, from Hellerman, Ltd., Tinsley Lane, Crawley, Sussex, gives details of the company's new pressure-type cable terminals, together with illustrations of the use of the crimping tool and application of binding sleeves and printed markers.

* * *

Mr. Charles Hemm has been appointed Dunlop's director of projects (general rubber goods). During the war he was general manager of the company's barrage balloon division and acted as production adviser to M.A.P. on the manufacture of all low-pressure inflatable devices.

* * *

The small tools division of Wm. Jessop and Sons, Ltd., of Sheffield, have adopted a new system of indicating, on the shank ends of their carbide-tipped tools, the grade of tip fitted; thus even when the tools are stacked close together in large racks a glance is sufficient to identify the item required.

* * *

The Institute of Petroleum (26 Portland Place, London, W.1) has recently published in book form, at 30s, the papers given at the Institute's summer meeting at Llandudno last May; discussions are also included. Among the papers are *Air Transport Fuels*, by A. L. Parker, and *Lubrication of Aircraft*, by M. F. Hoare, A. L. Parker and J. T. Tyson.

* * *

E.M.I. Electronics, Ltd., have lately produced three new models of stroboscopic balancing machines capable of dealing with rotors of various kinds up to 24in in diameter and 150 lb in weight. They are designed to measure out-of-balance forces producing displacements as small as 0.000025in. The amount of unbalance is visually indicated on a meter and its location is shown by the stroboscope lamp. The new machines are to be on view for the first time at the Electrical Engineers' Exhibition at Earls Court, London, from March 15th to 29th.

* * *

Sheepbridge Engineering, Ltd., announce that, by arrangement with the German firm of Mahle-K.G., they have secured United Kingdom manufacturing and sales rights for a special process of chromium-plating light alloy I.C. engine cylinders and similar components.

* * *

Claimed to challenge the best the Continent can produce in the way of extremely high precision lathes, a new machine produced by Hardinge Machine Tools, Ltd., Feltham, Middlesex, is stated to combine with its precision both robustness and high speed of operation.

* * *

Two new products of Allweather Paints, Ltd., 36, Great Queen Street, London, W.C.2, are a paint stated to withstand temperatures as low as -60 deg F, and the effects of acid, alkali, brine and ammonia, without losing its efficiency in surface protection; and a chlorinated, rubber-based, mould-resistant paint incorporating a fungicide which will not cause embrittlement or other deterioration of the paint film.

* * *

From Light Soldering Developments, Ltd., 106 George Street, Croydon, Surrey, come notes on their various items of light soldering equipment. Among these is the "Permabit" soldering instrument, evolved in order to overcome the recognized drawbacks of copper bits. It is claimed that the bit lasts indefinitely, does not become pitted or lose its face, and requires no re-shaping, filing or maintenance. Where maximum heat is required, copper bits are available with tips made of "Permabit" material.

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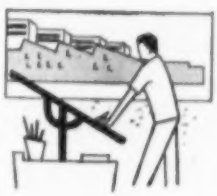

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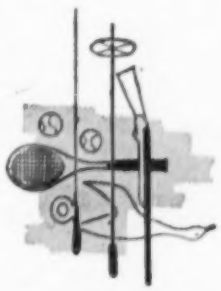

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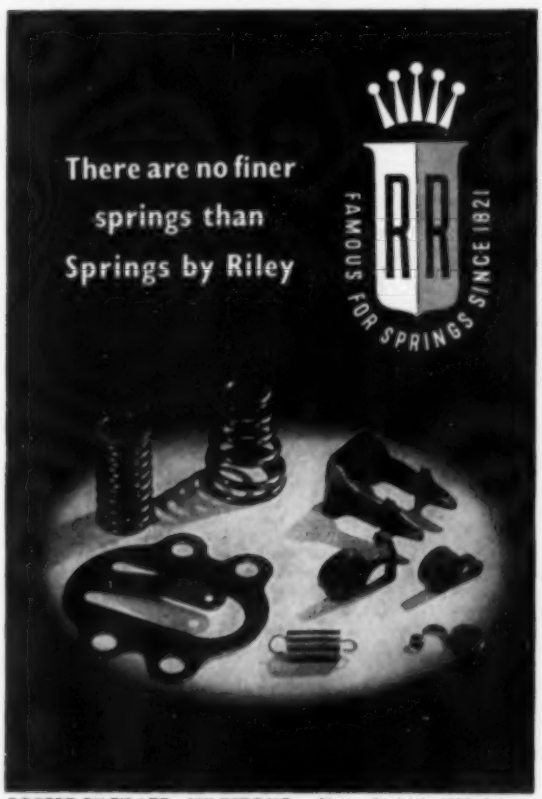

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PATENTS

THE proprietors of British patent No. 662,313, for "Improvements in removable hoods for the cockpits of aircraft," desire to enter into negotiations with a firm or firms for the sale of the patent or for the grant of licences thereunder. Further particulars may be obtained from Marks and Clerk, 57 and 58 Lincoln's Inn Fields, London, W.C.2. [3364

PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:—

FROM: British Overseas Airways Corporation, of Airways House, Great West Road, Brentford, Middlesex:—

APPLICATION No. 460. For permission for a period of 10 years to extend to Djarkata, Darwin, Cloncurry and Sydney the All-Freight Service which they operate between London and Singapore on the route set out as Route 1 in Schedule "B," Part I of the Terms of Reference issued to the Air Transport Advisory Council by the Minister of Civil Aviation on 30th July, 1952.

APPLICATION No. 461. For permission to include a traffic stop at New Delhi on their Normal Scheduled Service operated on the route between London and Hong Kong, set out as Route 3 in Schedule "A," Part I, of the Terms of Reference issued to the Air Transport Advisory Council by the Minister of Civil Aviation on 30th July, 1952.

APPLICATION No. 462. For permission to make traffic stops at both Basra and Behrein on their Normal Scheduled Service operated on the route between London and Singapore, set out as Route 5 in Schedule "A," Part I, of the Terms of Reference issued to the Air Transport Advisory Council by the Minister of Civil Aviation on 30th July, 1952.

FROM: Hunting-Clan Air Transport, Ltd., of 5, Fitzhardinge Street, Portman Square, London, W.1.:—

APPLICATION No. 90/2. For permission to increase their frequency up to eight services weekly on their Internal Service on the route Newcastle-Manchester which they are approved to operate for the period up to 31st March, 1960.

APPLICATION No. 91/2. For permission to increase their frequency up to eight services weekly on their Internal Service on the route Newcastle-Glasgow (Renfrew) which they are approved to operate for the period up to 31st March, 1960.

APPLICATION No. 465. From Fairways (Jersey), Ltd., of Midland Bank Chambers, Mulcaster Street, St. Helier, Jersey, Channel Islands. For a Seasonal Inclusive Tour Service with Avro XIX aircraft in conjunction with Jersey and Channel Islands Holiday Tours, Ltd., for the carriage of passengers and supplementary freight between Jersey and London (Blackbushe) with an optional intermediate traffic stop at Guernsey at a frequency of up to 10 services weekly on Friday, Saturday and Sunday only during the season from May to September inclusive each year, for a period of seven years, commencing 1st May, 1955.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on 30th July, 1952. Any representations or objections with regard to these applications must be made in writing, stating the reasons, and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3, Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections.

THE Air Transport Advisory Council also give notice that the following applications have now been withdrawn:—

APPLICATIONS Nos. 450 and 459 from Air Kruise (Kent), Ltd., of Lympne Airport, Kent, for Seasonal Inclusive Tour Services with Dakota aircraft in conjunction with Transglobe, Ltd. (Birmingham) between Birmingham (Elmdon) and Basle and between Birmingham (Elmdon) and Ostend, respectively, which were advertised in "The Times," "The Aeroplane" and "Flight" on 21st January and 11th February, 1955. [3369

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FOR further particulars and application forms write (preferably by postcard) to Secretary, Civil Service Commission, Burlington Gardens, London, W.1, quoting No. 1002/55. Completed application forms to be returned by March 17th, 1955. [3325

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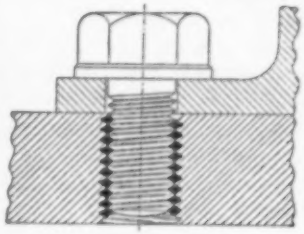

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The engagement of persons answering these advertisements must be made through the local office of the Ministry of Labour and National Service, etc., if the applicant is a man aged 18-64 or a woman aged 18-59 inclusive, unless he or she or the employer is excepted from the provisions of The Notification of Vacancies Order 1952.

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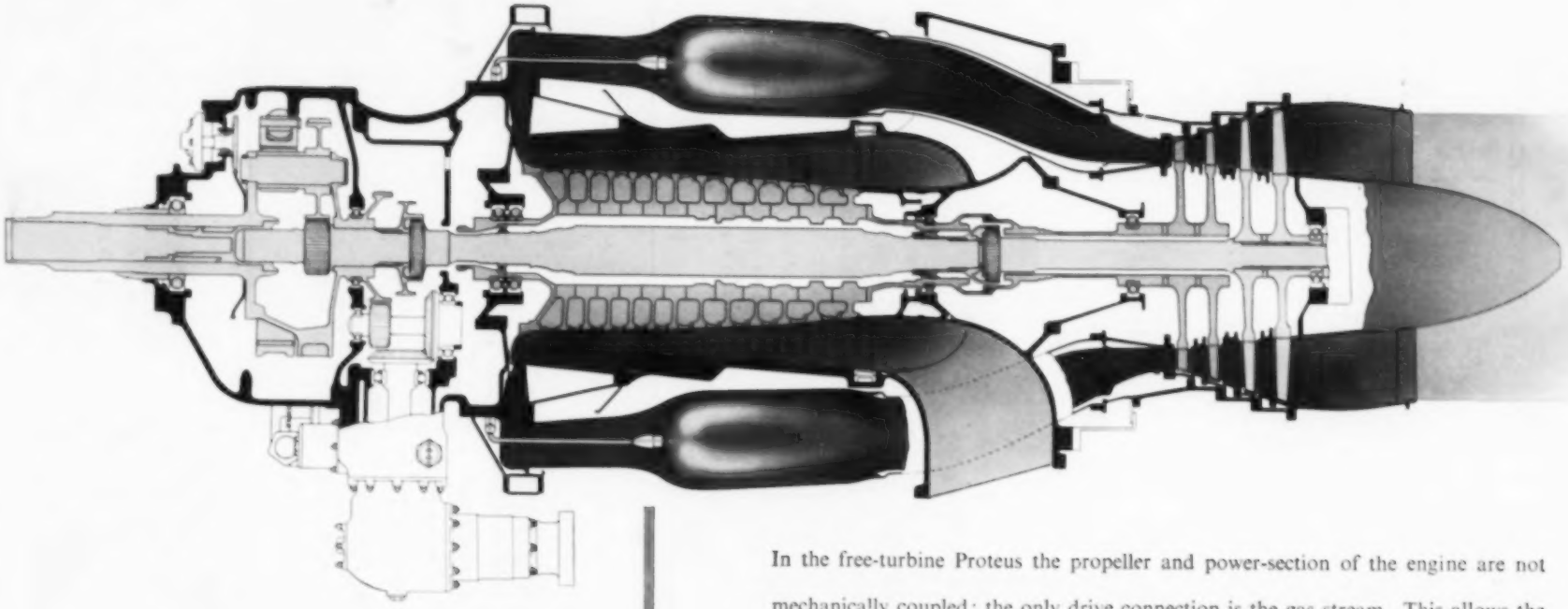

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